User's manual

Asynchronous - Firmware version 12.1

BLU

SUMMARY

1 INTRODUCTION 4
1.1 PARAMETERS (P) 4
1.2 CONNECTIONS (C) 5
1.3 INPUT LOGIC FUNCTIONS (I) 5
1.4 INTERNAL VALUES (D) 5
1.5 OUTPUT LOGIC FUNCTIONS (O) 5

2 ASYNCHRONOUS PARAMETERS 6
2.1 DRIVE AND MOTOR COUPLING 6

2.1.1 Drive Plate 6
2.1.2 Motor Plate 8
2.1.3 Motor Sensor 9
2.1.4 Autotunig Control and Motor Measured Model 11
2.1.5 Identifying Models of Induction Motor 18
2.1.6 Speed Test 22
2.1.7 Quick Start-Up 24

2.2 MOTOR CONTROL 25

2.2.1 Acceleration Ramps and Speed Limit 26
2.2.2 Speed Limit 28
2.2.3 Speed Control 28
2.2.4 Torque and Current Limits 33
2.2.5 Current Control 35
2.2.6 Drive Torque Control 36
2.2.7 Voltage/Flux Control 37

2.3 PROTECTION 40

2.3.1 Voltage Limits 40
2.3.2 Thermal Protection 47
2.3.3 Braking Resistence Thermal Protection 49

2.4 V/F CONTROL 51

2.4.1 Automatic Setting of Working Voltage/Frequency 52
2.4.2 Manual Setting of Working Voltage/Frequency Characteristic 53
2.4.3 Load Effect Compensation 54
2.4.4 Particular Control Functions 55

2.5 SENSORLESS 56

3 STANDARD APPLICATION 57
3.1 INPUTS 57

3.1.1 Analog Reference 57
3.1.2 Current Analog Reference 4÷20ma 59
3.1.3 Dead Zone 63
3.1.4 Digital Speed Reference 63
3.1.5 Frequency Speed Reference 65
3.1.6 Digital Inputs Configurations 70
3.1.7 Second Sensor 71

3.2 OUTPUT 72

3.2.1 Digital Output Configurations 72
3.2.2 Analog Output Configurations 73
3.2.3 Frequency Output 76

3.3 MOTION CONTROL 80

3.3.1 Incremental Position Loop 80
3.3.2 Pid Controller 82
3.3.3 Stop In Position 84
3.3.4 Motor Holding Brake 89

4 CATALOG APPLICATIONS 90
4.1 INPUTS 90

4.1.1 Analog Reference 90
4.1.2 Digital Speed Reference 91
4.1.3 Frequency Speed Reference 91
4.1.4 Digital Inputs Configurations 91
4.1.5 Second Sensor 92

4.2 OUTPUT 93

4.2.1 Digital Outputs Configurations 93
4.2.2 Analog Outputs Configurations 94
4.2.3 Frequency Output 95

4.3 MOTION CONTROL 95

5 GENERIC PARAMETERS 97
5.1 KEYS 97
5.2 DATA STORING 97

5.2.1 Storage And Recall Of The Working Parameters 97

5.3 DIGITAL COMMANDS AND CONTROL 99

5.3.1 Drive Ready 99
5.3.2 Drive Switch On / Run 100
5.3.3 Drive Switch Off / Stop 100
5.3.4 Safety Stop 100

5.4 PWM SYNCHRONIZATION (STANDARD APPLICATION) 101

6 ALARMS 102
6.1 MAINTENANCE AND CONTROLS 102

6.1.1 Malfunctions Without An Alarm: Troubleshooting 102
6.1.2 Malfunctions With An Alarm: Troubleshooting 103
6.1.3 MiniOPDE's Specific Alarms 107

7 DISPLAY 108
7.1 PHYSICAL DISPOSITION 108
7.2 LAYOUT OF THE INTERNAL variables 108

7.2.1 Parameters (Par) 109
7.2.2 Application Parameters (App) 109

7.2.3 Connections (Con) 110
7.2.4 Allarms (All) 110
7.2.5 Internal Values (Int) 111
7.2.6 Logic Functions Of Input (Inp) 111
7.2.7 Logic Functions Of Output (Out) 112
7.2.8 Utilities Commands (UTL) 112
7.2.9 Fieldbus Parameters (FLB) 113

7.3 IDLE STATE 113
7.4 MAIN MENU 113

7.4.1 Sub-Menu of Parameters, Application Parameters and Connections Management (Par, App e Con) 114
7.4.2 Visualization of the Internal Values (INT) 116
7.4.3 Alarms (ALL) 116
7.4.4 Visualization of the Input and Output (Inp and Out) 117

7.5 PROGRAMMING KEY 118

8 LIST OF PARAMETERS 119

1 INTRODUCTION

To help the customer during the configuration of the drive, the manual is organized to follow faithfully the structure of the configurator (OPDExplorer) that allows, according to a logical sequence, to set all the sizes needed for the proper functioning of the drive.

In particular, each chapter refers to a specific folder of OPDExplorer which includes all the relative parameters.

Also, at the beginning of each chapter of the manual, is showed the location of the folder in the OPDExplorer tree, which the chapter refer, and the complete table of sizes of the folder in question.
The control values are divided as follows:

- Parameters
- Connections
- Input logic functions
- Internal values
- Output logic functions

In the tables of the control value, the last column on the right “Scale” shows the internal representation base of the parameters. This value is important if the parameters have to be read or written with a serial line or fieldbus and represent the factor which to divide the value stored to obtain the real value set, as following indicated:

$$\text{Value} = \frac{\text{Internal representation}}{\text{Scale}}$$

Examples:
MAIN_SUPPLY → P87 – Main supply voltage
Value = 400
Scale = 10
Int. rep. = 4000

1.1 PARAMETERS (P)

The parameters are drive configuration values that are displayed as a number within a set range. The parameters are mostly displayed as percentages, which is especially useful if the motor or drive size have to be changed in that only the reference values (**P61**÷**P65**) have to be modified and the rest changes automatically. The parameters are split up into free, reserved and BLU reserved parameters.
The following rules apply:

Free parameters (black text in OPDExplorer): may be changed without having to open any key, even when running;

Reserved parameters (blu text in OPDExplorer): may be changed only at a standstill after having opened the reserved parameter key in P60 or the BLU reserved parameters key in P99;

Reserved parameters (violet text in OPDExplorer): may be changed only at a standstill after having opened the reserved parameters key in P99. While the key for these parameters is closed, they will not be shown on the display.

Take careful note of the reference values for each parameter so that they are set correctly.

1.2 CONNECTIONS (C)

The connections are drive configuration values that are displayed as a whole number in the same way as a digital selector.
They are split up into free, reserved and reserved connections, and are changed in the same way as the parameters.
The internal representation base is always as whole number.

1.3 INPUT LOGIC FUNCTIONS (I)

The input logic functions are 32 commands that come from configured terminal board logic inputs, from the serial line, and from the fieldbus. The meaning of this logical functions depend on the application, so please refer to specific documentation.

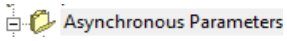
1.4 INTERNAL VALUES (D)

Internal values are 128 variables within the drive that can be shown on the display or via serial on the supervisor. They are also available from the fieldbus.
The first 64 values are referred to motor control part and are always present. The second 64 values are application specific.
Pay close attention to the internal representation base of these values as it is important if readings are made via serial line or fieldbus.

1.5 OUTPUT LOGIC FUNCTIONS (O)

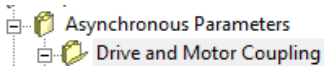
The logic functions are 64, the first 32 display drive status and second 32 are application specific. All output functions can be assigned to one of the 4 logic outputs.

2 ASYNCHRONOUS PARAMETERS



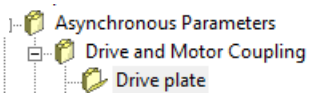
The “Asyncrhonous Parameters” are used to control the current or speed of a feedback vector induction motor. The speed and current reference values are generated by the application. See the application parameters for further information. As an absolute position value is not required for the sensors (managed with an optional internal electronic board) incremental TTL Encoders and incremental Sin/Cos Encoders may be used. Absolute sensors such as Resolver can also be used, as can digital sensors such as Endat or Hiperface if required.
The “Asyncrhonous Parameters” also manages the auto-tuning test, which is crucial if the control is to adapt perfectly to the motor and to ensure excellent dynamic performance all-round.

2.1 DRIVE AND MOTOR COUPLING



This section is usefull during motor start-up to obtain the best coupling between drive and motor. It’s very important to follow the correct sequence explained in the next paragraphs

2.1.1 Drive Plate



Name	Description	Min	Max	Default	UM	Scale
MAIN_SUPPLY_SEL	C53 - Supply voltage	0	2	0		1
MAIN_SUPPLY	P87 - Main Supply voltage	180.0	780.0	400	V rms	10
DRV_I_NOM	P53 - Rated drive current	0.0	3000.0	0	A	10
DRV_I_PEAK	P113 - Maximum drive current	0.0	3000.0	0	A	10
I_OVR_LOAD_SEL	C56 - Current overload	0	3	3		1
PRC_DRV_I_MAX	P103 - Drive limit current	0.0	800.0	200	% DRV_I_NOM	40.96
DRV_F_PWM	P101 - PWM frequency	1000	16000	5000	Hz	1
DRV_F_PWM_CARATT	P156 - PWM frequency for drive definition	1000	16000	5000	Hz	1
DRV_E_CARATT	P167 - Characterization voltage	200.0	780.0	400	V rms	10
LEM_SEL	C22 - LEM selection	0	1	1		1
DRV_TH_MODEL	C94 - Drive thermal model	0	2	0		1
DRV_K_ALTITUDE	P195 - Drive derating with altitude	0.0	200.0	100.0	%	163.84
T_RAD	P104 - Radiator time constant	10.0	360.0	80	s	10
T_JUNC	P116 - Junction time constant	0.1	10.0	3.5	s	10
OVR_LOAD_T_ENV	P155 - Ambient temperature reference value during overload	0.0	150.0	40	°C	10
EN_PWM _VAR	C68 - Enable PWM frequency reduction	0	1	0		1
PWM_RID_F_MAX	P196 - Max frequency for PWM reduction	0.0	1000.0	10.0	Hz	10
PWM_MIN	P197 - Minimum PWM frequency	1000	16000	5000.0	Hz	1
ISR_PWM	Control Routines Frequency			5000	Hz	1
IGBT_PWM	IGBT Frequency			5000	Hz	1
DEAD_TIME_SW	P157 - Dead time software duration	0.0	20.0	4	µs	10
DEAD_TIME_HW	P198 - Dead time hardware duration	0.0	20.0	0.0	µs	10
MIN_PULSE	P199 - Minimum command pulse duration	0.0	20.0	1.0	µs	10
DC_BUS_FULL_SCALE	C24 - DC voltage drive full scale	0	2	0	V	1
RECT_BRIDGE_SEL	C45 - Rectification bridge	0	1	0		1
EN_NEW_STO	C58 - Enable new STO management	0	1	0		1

This parameters are related to the drive characteristic. The user has to set only the main supply voltage and select the current overload.

2.1.1.1 Drive Current Overload Selection

Four types of drive overload can be set on **C56**

C56	Overload type for rated drive current (P53)
0	120% for 30 seconds
1	150% for 30 seconds
2	200% for 30 seconds
3	200% for 3 seconds and 155% for 30 seconds

NB: the choice also changes the rated drive current as shown by the tables in the installation file and the correct value is always displayed in ampere rms in **P53**.
The delivered current is also used to calculate the operating temperature reached by the power component junctions with the drive presumed to be working with standard ventilation at the maximum ambient temperature permitted.
If this temperature reaches the maximum value permitted for the junctions, the delivered power limit is restricted to a value that is just over the rated drive current, i.e. the system's effective thermal current (see following table).

Now the drive will only overload if the temperature drops below the rated value, which will only occur after a period of operation at currents below the rated current.

The junction temperature calculation also considers the temperature increase that occurs while operating at low frequencies (below 2.5 Hz) due to the fact that the current is sinusoidal and thus has peak values that are higher than the average value. With electrical operating frequencies lower than 2.5Hz, the drive goes into maximum overload for 20-30ms after which the maximum current limit is reduced by $\sqrt{2}$ as shown by the following table:

C56	Max. drive current	Drive thermal current	Limit below 2.5 Hz
0	120% I NOM AZ for 30 seconds	103% I NOM AZ	84% I NOM AZ
1	150% I NOM AZ for 30 seconds	108% I NOM AZ	105% I NOM AZ
2	200% I NOM AZ for 30 seconds	120% I NOM AZ	140% I NOM AZ
3*	200% I NOM AZ for 3 seconds 155% I NOM AZ for 30 seconds	110% I NOM AZ	140% I NOM AZ

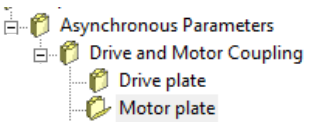
N.B. = the overload time illustrated is calculated with the drive running steady at the rated motor current. If the average delivered current is lower than the rated motor current, then the overload time will increase. Thus the overload will be available for a longer or identical time to the ones shown.
N.B. 3* = the 200% overload is available until junction temperatures are estimated to be 95% of the rated value; at the rated value the maximum limit becomes 180%. For repeated work cycles, BLU is available to estimate the drive's actual overload capacity

2.1.1.2 New Current Overload Function

With connection C94 "DRV_TH_MODEL"=2 is possible to enable a new current overload management. Please contact BLU spa for further informations.

2.1.1.3 Double Update Function

With connection C68 "EN_PWM_VAR"= 2 (Double Update) the motor control routines have the refresh frequency set with P101 "DRV_F_PWM", but the real PWM frequency (for IGBT control) is half of that value, for reduce power loses and consequently Drive derating.
When the Double Update function is enabled, the second sensor is no louger managed.
In addiction, the minimum ratio between the control frequency and the output frequency will always be 9, therefore there will be an automatic control frequency change based on output frequency.



2.1.2 Motor Plate

Name	Description	Min	Max	Default	UM	Scale
PRC_MOT_I_NOM	P61 - Rated motor current (I NOM MOT)	10.0	100.0	100	% DRV_I_NOM	327.67
MOT_V_NOM	P62 - Rated motor voltage	100.0	1000.0	380	Volt	10
MOT_F_NOM	P63 - Rated motor frequency	10.0	800.0	50.0	Hz	10
PRC_MOT_V_MAX	P64 - Max. operating voltage	1.0	200.0	100	% MOT_V_NOM	40.96
MOT_SPD_MAX	P65 - Max. operating speed (n MAX)	50	60000	2000	RPM	1
MOT_SPD_MAX_MUL	C78 - Motor speed max multiplication factor	Range		0		1
		0	X1			
		1	X10			
MOT_COS_PHI	P66 - Nominal power factor	0.500	1.000	0.894		1000
MOT_POLE_NUM	P67 - Number of motor poles	1	12	4		1
PRC_MOT_I_THERM	P70 - Motor thermal current	10.0	110.0	100	% PRC_MOT_I_NOM	10
MOT_TF_THERM	P71 - Motor thermal time constant	30	2400	180	s	1
MOT_N_NOM	Motor nominal speed			0	rpm	1
MOT_F_MAX	Motor max frequency			0	Hz	10

Setting the parameters that establish the exact type of motor used is important if the drive is to run correctly. These parameters are:

Name	Description
PRC_MOT_I_NOM	P61 - Rated motor current (I NOM MOT)
MOT_V_NOM	P62 - Rated motor voltage
MOT_F_NOM	P63 - Rated motor frequency
MOT_POLE_NUM	P67 - Number of motor poles

These parameters are fundamental in that they are the basis of all the motor operating characteristics: frequency, speed, voltage, current, torque and thermal protection.
P62 and P63 can be read directly on the motor rating plate and P61 can be calculated with the following formula:

P61 = (Inom_motor *100.0))/(Inom_drive)

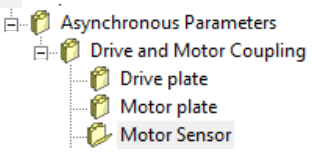
Example: Drive: OPEN 22
Inom_drive = 22A overload 200%
Motor: MEC series, Vn = 380V, f = 50Hz, Inom_motore = 20A,
P61 = (20*100)/22 = 90.9%
P62 = 380.0
P63 = 50.0

There are also parameters that establish the maximum values for voltage, thermal current and operating speed:

Name	Description
PRC_MOT_V_MAX	P64 - Max. operating voltage
MOT_SPD_MAX	P65 - Max. operating speed (n MAX)
PRC_MOT_I_THERM	P70 - Motor thermal current
MOT_TF_THERM	P71 - Motor thermal time constant

These important parameters must be specified alongside the exact characteristics of the feedback sensor used. Once the sensor has been established, the "**Sensor and motor pole tests**" can be carried out (enabled with C41) which will confirm that the parameters have been set correctly.

2.1.3 Motor Sensor



Name	Description	Min	Max	Default	UM	Scale
SENSOR_SEL	C00 - Speed sensor	Range		1		1
		0	Sensorless			
		1	Encoder			
		4	Resolver			
		5	Resolver DDC			
		8	Sin/Cos incr			
		10	Endat 1317			
		11	Endat 1329			
		14	Endat 125			
		15	Endat 129			
		20	Biss AD361219			
		21	Biss RA18			
RES_POLE	P68 - Number of absolute sensor poles	1	12	2		1
ENC_PPR	P69 - Number of encoder pulses/revolution	0	60000	1024	pulses/rev	1
EN_TIME_DEC_ENC	C74 - Enable incremental encoder time decode	0	1	0		1
RES_TRACK_LOOP_BW	P89 - Tracking loop bandwidth direct decoding of resolver	100	10000	1800	rad/s	1
RES_TRACK_LOOP_DAMP	P90 - D Traking loop bandwidth	0.00	5.00	0.71		100
RES_CARR_FRQ_RATIO	C67 - Resolver carrier frequency	Range		0		1
		-3	f PWM ÷ 8			
		-2	f PWM ÷ 4			
		-1	f PWM ÷ 2			
		0	f PWM			
		1	f PWM x 2			
		2	f PWM x 4			
		3	f PWM x 8			
EN_SENSOR_TUNE	U04 - Enable sensor autotuning	0	2	0		1
EN_INV_POS_DIR	C76 - Invert positive cyclic versus	0	1	0		1
MOT_POS	Actual position			0	Sensor pulses	1
MOT_TURN_POS	D36 - Absolute mechanical position (on current revolution)			0	+/-16384	1
MOT_N_TURN	D37 - Number of revolutions			0		1
KP_SINCOS1_CHN	P164 - Resolver or Incremental Sin/Cos sine and cosine signal amplitude compensation	0.0	200.0	100	%	163.84
OFFSET_SIN1	P165 - Resolver or Incremental Sin/Cos sine offset	-16383	16383	0		1
OFFSET_COS1	P166 - Resolver or Incremental Sin/Cos cosine offset	-16383	16383	0		1
PRC_RES_AMPL	D23 - Amplitude resolver signals	0	800	0	%ALL_THR	40.96
OFFSET_SINCOS_ENC	D38 - Compensation Sin/Cos analog/digital term			0	pulses	1
SENSOR_FRQ_IN	D39 - Input frequency			0	kHz	16
HW_SENSOR1	D63 - Sensor1 presence			0		1
SENS1_ZERO_TOP	D55 - Sensor1 Zero Top			0	pulses	1
RES_DDC_BW	C66 - Resolver DDC bandwidth	0	1	0	Hz	1
EN_SLOT_SWAP	C19 - Enable sensor slot swap	0	1	0		1
MOTOR_SENSOR_RES	Motor sensor resolution			0		1

For correct motor sensor setup is necessary to set the motor sensor present:

Name	Description
SENSOR_SEL	C00 - Speed sensor

and, for the specific sensor present, the following parameters.

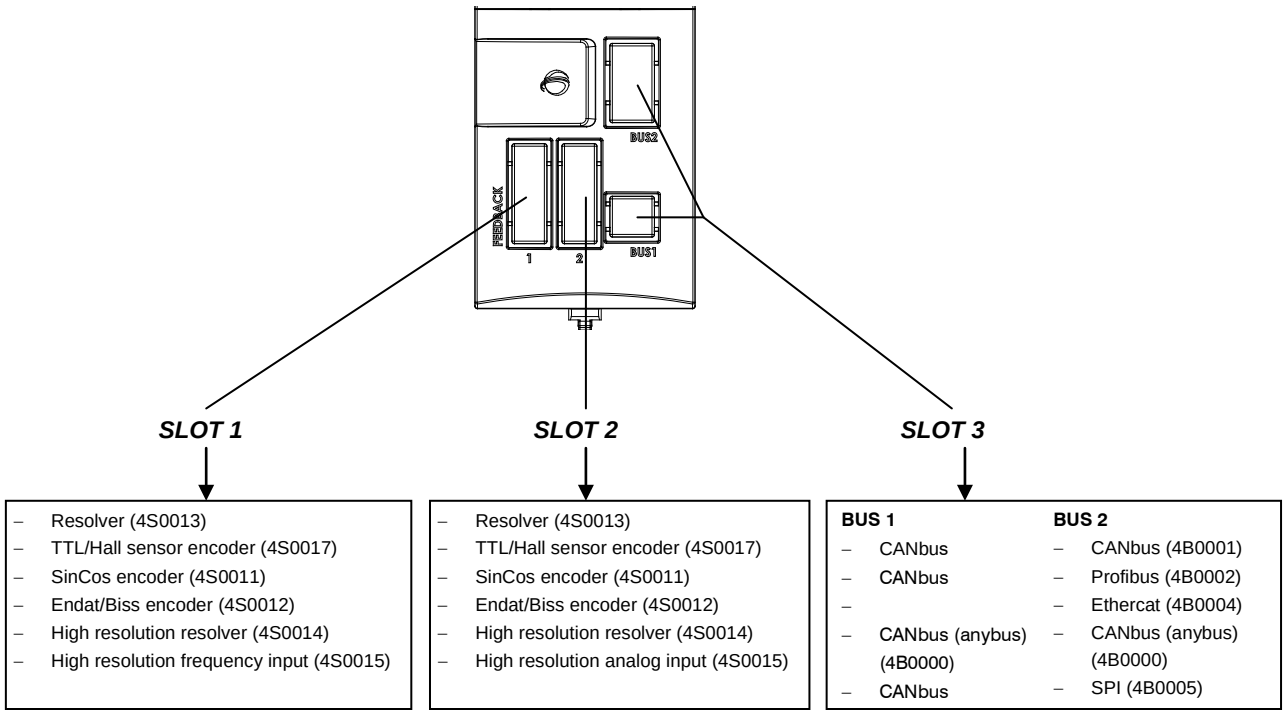
For the TTL encoder and the incremental sin-cos encoder:

Name	Description
ENC_PPR	P69 - Number of encoder pulses/revolution

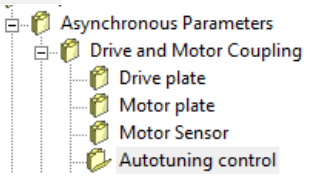
And for the resolver:

Name	Description
RES_POLE	P68 - Number of absolute sensor poles
RES_CARR_FRQ_RATIO	C67 - Resolver carrier frequency

After that is necessary proceed with the auto tuning procedure.
NOTE: usually SLOT1 is used to connect motor sensor, and SLOT2 for other sensors. With connection C19 is possible to swap the slot meaning, and use Slot2 to read motor sensor.



2.1.4 Autotunig Control and Motor Measured Model



Name	Description	Min	Max	Default	UM	Scale
EN_TEST_CONN	C41 - Enable sensor and motor phase tests	Range 0 No 1 Yes 2 Yes, without sensor tuning		0		1
PRC_I_TEST_CONN	P114 - Current in connection tests for UVW, Poles and reading Rs	0.0	100.0	100	% DRV_I_NOM	327.67
EN_AUTOTUNING	C42 - Enable auto-tunings	Range 0 No 1 Test 1 and 2 2 Test 3 and 4 3 All		0		1
DIS_DEF_START_AUTO	C75 - Disable Autotuning starting from default values	0	1	0		1
TEST3-4_ACC_TIME	P121 - Test 3 and 4 acceleration time	0.01	199.99	4.0	s	100
PRC_I_TEST_DELTA_VLS	P129 - Test current to establish VLS	0.0	100.0	30.0	%	327.67
TEST_CONN_PULSES	Connection test pulses counted	-19999	19999	0		1
TEST_CONN_RES_RATIO	Connection test motor and sensor pole ratio			0		100
EN_TEST_SPD	U01 - Enable test of start-up time	Range 0 Not enabled 1 Start up 2 Step		0		1
TEST_SPD_T_MAX	P130 - Torque during start-up test	0.0	100.0	100	% MOT_T_NOM	40.96
TEST_SPD_MAX	P132 - Speed during start-up test	-100.00	100.00	100	% MOT_SPD_MAX	163.84
TEST_SPD_SPACE_MAX	P134 - Maximum revolutions during start-up test	0.00	3000.0	100	revolutions	10
PRC_MOT_FRICTION	P136 - Friction torque	0.0	100.0	0	% MOT_T_MOM	40.96
START_TIME	P169 - Start up time	0	19999	100	ms	1
EN_I_VECTOR	U10 - Enable Current Vector for Power Part Test	0	1	0		1
I_VECTOR_FREQ	U11 - Current Vector frequency for Power Part Test	0	200	50	Hz	1
PRC_DRV_I_PEAK	P40 - Current limit	0.0	250.0	200	% DRV_I_NOM	40.96

2.1.4.1 Auto-Tuning Procedures

The first step for the auto-tuning procedure is the sensor test.
After to set the correct parameters in the motor sensor section is necessary to complete the auto-tuning procedure for the sensor present and selected.
With C41=1 it's possible to enable the sensor test with automatic sensor signals offset and gain compensation. If the user prefers to compensate sensor offset and gain manually, setting C41=2 it's possible to execute sensor test without signals compensation.

2.1.4.1.1 Sensor Tests

This is the first test to be carried out. It is in three parts:

- Check that the direction of rotation of the motor phases and the sensor correspond;
- Automatic offset and gain sensor signals compensation
- Check that the number of motor poles is written correctly in parameter **P67** and the speed sensor used is set correctly.

Correct operation requires a no-load motor so decouple it from the load.

After setting the drive to STOP and opening the reserved parameter key (P60=95), set **C41=1** to enable the test. The following setting will appear on the display:

The drive is now ready to start the test. To start reading, enable RUN with its digital input or working with connection C21 (commands in series)Once the test has started, this setting will appear on the display:

and the motor will rotate in the positive direction first to ensure the direction matches and will then rotate again to ensure the motor phases and the sensor are set correctly.

During the test, the motor will make at last two revolution at low speed.
Do not worry if these revolutions are a little noisy.

If the drive sets off an alarm during the test, an error has occurred. Check to see which alarm has been triggered and deal with the problem accordingly:

- If **A14 code=1** is enabled, the test current is too low, check if the motor phases are correctly connected to the drive
- If **A14 code=0** is enabled, connections U,V,W do not match the internal phases of the drive. Invert two phases and repeat the test.
- If **A15 code=3** is enabled, the values set do not comply with the motor pole and sensor settings.

At the end of the test, check parameter **"TEST_CONN_PULSES"** and **"TEST_CONN_RES_RATIO"** as it may give some indication as to the problem.
The test is successful if this setting appears on the display:

and the drive does not trigger an alarm.
Now disable RUN by setting its digital input to 0 or clearing C21.
The subsequent tests can now be carried out.

2.1.4.2 TTL Encoder

2.1.4.2.1 Sensor Parameters

It's necessary to have set correctly the parameter **P69** (Encoder pulses per revolution) in order to define the Encoder

By default (**C74=0**) the speed is measuring counting the number of pulses in the PWM period.
This produces a poor resolution especially at low speed and the consequent need of signal filtering (see the related core document, P33 parameter of speed regulator).
Setting **C74=1** the speed calculation is done measuring the time between one Encoder pulse to the other. This technique has a maximum resolution of 12.5 ns, so the measure can be very accurate.
The Encoder time decode needs Incremental Encoder pulses with duty-cycle of 50%, a correct pulses time distribution and the cables would be shielded very well

2.1.4.2.2 Speed Sensor Test

It is in two parts:

- Check that the direction of rotation of the motor phases and the Encoder correspond;
- Check that the number of motor poles is written correctly in parameter **P67** and the Encoder used is correctly define as pulses per revolution with parameter **P69**

Correct operation requires a no-load motor so decouple it from the load.

After setting the drive to STOP and opening the reserved parameter key (P60=95), set **C41=1** to enable the test. To start the test enable RUN command with its digital input.
Once the test has started the motor will rotate in the positive direction at low speed and all Encoder edges are counted.

During the test, the motor will make a complete revolution at low speed.
Do not worry if this revolution is a little noisy

In the first step is checked if the cyclic sense of motor phases and Encoder channels is the same:
after 1 second parameter TEST_CONN_PULSES is updated with the test result and the drive consequently goes in alarm A14 or t starts the second test:

- **TEST_CONN_PULSES=0** : meaning that is missing at least one Encoder channel, therefore A14 code 0 is triggered
- **TEST_CONN_PULSES<0** : meaning that Encoder channels are exchanged, therefore A14 code 0 is triggered
- **TEST_CONN_PULSES>0** : everything is ok

In the second part is checked the Encoder pulses reading, well known from P69 parameter the number of edges in a mechanical turn.

- At the end of the test, TEST_CONN_PULSES is updated again with the total edges number: **TEST_CONN_PULSES - P69|/ TEST_CONN_PULSES < 12,5%** : test is successful, otherwise the alarm A15.3 is triggered. In the first check if it is correct the Encoder number of pulses per revolution and the number of motor poles;
- **TEST_CONN_PULSES < P69**: the real pulses counted are less than expected. Encoder could have some problems or the motor load is too high. Try to increase the test current with parameter P114 that is the percentage of rated drive current applied in the test;
- **TEST_CONN_PULSES > P69** : the real pulses counted are more than expected. Could be some noise in the Encoder signals.

Note: for encoder with more than 8192 ppr the data showed in TEST_CONN_PULSES loses of meaning

The test is successful if the drive switch off and does not trigger an alarm. Now disable RUN command by setting its digital input to 0. The subsequent tests can now be carried out.

2.1.4.3 Resolver/Resolver DDC

2.1.4.3.1 Sensor Parameters

It's necessary have to set correctly the parameter **P68**
Note: starting from revision 12.00 it's possible to work with any motor/resolver poles combination.
In the internal value D23 is showed the actual resolver signals amplitude percent of minimum admitted value. Try to change C67 (resolver carrier frequency) in order to maximize D23.

2.1.4.3.2 Speed Sensor Test

It is in three parts:

- Check that the direction of rotation of the motor phases and the Resolver correspond;
- Autotuning resolver signals
- Check that the number of motor poles is written correctly in parameter **P67** and the Resolver used is correctly define as poles number with parameter **P68**

Correct operation requires a no-load motor so decouple it from the load.

After setting the drive to STOP and opening the reserved parameter key (P60=95), set **C41=1** to enable the test. To start the test enable RUN command.
Once the test has started the motor will rotate in the positive direction at low speed and some measure are done on Resolver signals.

During the test, the motor will make two revolutions at low speed.
Do not worry if this revolutions are a little noisy.

In the first step is checked if the cyclic sense of motor phases and Resolver channels is the same: after 1 second parameter **TEST_CONN_PULSES** is updated with the pulses number counted (there are 65536 pulses every turn/Resolver polar couples) and the drive consequently goes in alarm A14 or it starts the second test:

- **TEST_CONN_PULSES <0** : meaning that Resolver channels are exchanged, therefore A14.0 is triggered
- **TEST_CONN_PULSES >0** : everything is ok

In the second part is checked the Resolver channels reading.

At the end of the test, **TEST_CONN_RES_RATIO** is updated again with the measured ratio between motor and resolver polar couple number.

If the ratio isn't correct the alarm A15.3 is triggered. In the first check if it is correct the Resolver poles number and the number of motor poles, with help of **TEST_CONN_RES_RATIO.**
The test is successful if the drive switch off and does not trigger an alarm. Now disable RUN command by setting its digital input to 0. The subsequent tests can now be carried out.

Sensor presence is checked only with STO off and power soft start completed.

2.1.4.4 Incremental SIN COS Encoder

2.1.4.4.1 Sensor Parameters

It's necessary to have set correctly the parameter P69

2.1.4.4.2 Speed Sensor Test

It is in three parts:

- Check that the direction of rotation of the motor phases and the Encoder correspond;
- Autotuning incremental sin/cos signals
- Check that the number of motor poles is written correctly in parameter **P67** and the Encoder used is correctly define as pulses per revolution with parameter **P69**

Correct operation requires a no-load motor so decouple it from the load.

After setting the drive to STOP and opening the reserved parameter key (P60=95), set **C41=1** to enable the test. To start the test enable RUN command.
Once the test has started the motor will rotate in the positive direction at low speed and all Encoder edges are counted.

During the test, the motor will make a complete revolution at low speed.
Do not worry if this revolution are a little noisy

In the first step is checked if the cyclic sense of motor phases and Encoder channels is the same:
after 1 second parameter TEST_CONN_PULSES is updated with the test result and the drive consequently goes in alarm A14 or it starts the second test:

- **TEST_CONN_PULSES=0** : meaning that is missing at least one Encoder channel, therefore A14 code 0 is triggered
- **TEST_CONN_PULSES <0** : meaning that Encoder channels are exchanged, therefore A14 code 0 is triggered
- **TEST_CONN_PULSES >0** : everything is ok

In the second part is checked the Encoder pulses reading, well known from P69 parameter the number of edges in a mechanical turn.
At the end of the test, TEST_CONN_PULSES is updated again with the total edges number:

- **TEST_CONN_PULSES - (P69)|/(P69) < 12,5%** : test is successful
  otherwise the alarm A15.3 is triggered. In the first check if it is correct the Encoder number of pulses per revolution and the number of motor poles.
- **TEST_CONN_PULSES < (P69)**: the real pulses counted are less than expected. Encoder could have some problems or the motor load is too high. Try to increase the test current with parameter P114 that is the percentage of rated motor current applied in the test (default value 50%).
- **TEST_CONN_PULSES > (P69)** : the real pulses counted are more than expected. Could be some noise in the Encoder signals.

The test is successful if the drive switch off and does not trigger an alarm. Now disable RUN command. The subsequent tests can now be carried out.

2.1.4.4.3 Sin/Cos Absolute Position

Starting from 12.10 revision, the accuracy of absolute position is been improved.
Now a different behavior could be achieved using the first or the second OPDE SLOT:

- In the first SLOT the Sincos Zero Top is managed storing only the digital counter every turn. This is the classic solution, in this way the accuracy is ± 1 pulse.
- In the second SLOT the SinCos Zero Top is stored with 32 bits, only in correspondence of the first edge. In this case using a time stamp function is possible to increase the accuracy at less than 1/8 of pulse. Wanting to use this function with the main sensor (motor sensor) just swap the slots with C19.

Sensor presence is checked only with S.T.O. off and power soft start completed.

2.1.4.5 ENDAT 22 / BISS

BiSS sensor:

- **AD36 1219** with 19 bit Single turn, 12 bit Multi turn
- **RA18** with 18 bit Single turn

ENDAT 22 sensors with 17 bit Single turn or Multiturn; 25 bit or 29 bit single turn

- **ECI 1317** with 17 bit on turn
- **EQI 1329** with 17 bit on turn and 12 bit multi-turn
- **RCN 8580** with 29 bit on turn
- **ECN 125** with 25 bits on turn

2.1.4.5.1 Speed Sensor Test

This is the first test to be carried out. It is in two parts:

Check that the direction of rotation of the motor phases and the Endat/BiSS correspond;

Check that the number of motor poles is written correctly in parameter **P67** and the Endat/BiSS used works correctly.

Correct operation requires a no-load motor so decouple it from the load.

After setting the drive to STOP and opening the reserved parameter key (P60=95), set **C41=1** to enable the test. To start the test enable RUN command with its digital input.
Once the test has started the motor will rotate in the positive direction at low speed and all Encoder edges are counted.

During the test, the motor will make a complete revolution at low speed.
Do not worry if this revolution is a little noisy.

In the first step is checked if the cyclic sense of motor phases and Endat/BiSS sensor is the same:
after 1 second parameter TEST_CONN_PULSES is updated with the test result and the drive consequently goes in alarm A14 or t starts the second test:

- **TEST_CONN_PULSES <0** : meaning that motor phases have opposite cyclic sense of Endat/BiSS sensor.
- **TEST_CONN_PULSES >0** : everything is ok

In the second part is checked the sensor reading, well known that current test frequency is 0,5Hz the time needed for read again the same position is equal to:

$$\text{time test} = 2 \cdot \text{Motor polar couple number} \quad \text{[seconds]}$$

At the end of the test, TEST_CONN_PULSES is updated again with the time test measured in ms:

- **TEST_CONN_PULSES - time test| < 500ms** : test is successful

otherwise the alarm A15.3 is triggered. In the first check if it is correct the number of motor poles, with help of **TEST_CONN_PULSES.**

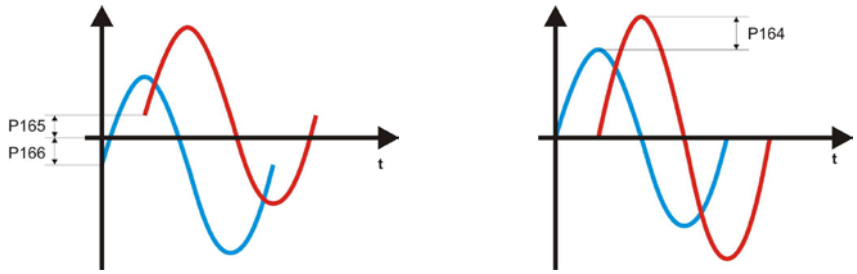
The test is successful if the drive switch off and does not trigger an alarm. Now disable RUN command by setting its digital input to 0. The subsequent tests can now be carried out.

2.1.4.5.2 Manual Fine Sensor Setup

With C41=1 in the first part of autotuning is done an automatic sensor signals offset and gain compensation. However every time it's possible to execute a manual sensor signal compensation.
In the following it's explained how to do the manual sensor setup.

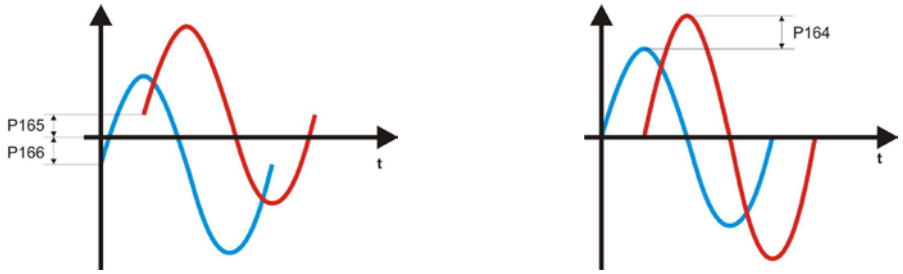
2.1.4.5.3 Fine Setup for Resolver

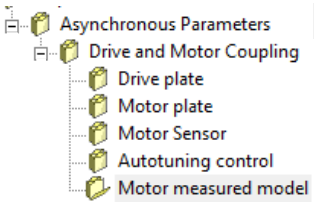
The fine tuning resolver setup allows to set, with a semiautomatic procedure, any offset and a multiplicative factor to adjust the signals acquired by the resolver channels in order to increase system performance.
The procedure begins by setting the utility command U04 (EN_SENSOR_TUNE) = 1 and giving a reference speed that the motor can run at 150 rpm. The motor have to run for about 30 seconds after stop the test is completed. Automatically updates the values of P165 and P166 (offset) and P164 (multiplication factor to adjust the amplitude)



2.1.4.5.4 Fine Setup for Incremental SIN/COS Encoder

The fine tuning incremental sin/cos encoder setup allows to set, with a semiautomatic procedure, any offset and a multiplicative factor to adjust the signals acquired by the incremental sin/cos encoder channels in order to increase system performance. The procedure begins by setting the utility command U04 (EN_SENSOR_TUNE)= 2 and giving a reference speed that the motor can do one o two turns . After stop the test is completed. Automatically updates the values of P165 and P166 (offset) and P164 (multiplication factor to adjust the amplitude)





2.1.5 Identifying Models of Induction Motor

Name	Description	Min	Max	Default	UM	Scale
PRC_MOT_T_MAX	P41 - Maximum torque at full load	0.0	800.0	400.0	% MOT_T_NOM	40.95
MOT_COS_PHI	P66 - Nominal power factor	0.500	1.000	0.894		1000
PRC_MOT_I_T_NOM	P72 - Nominal torque current	5.0	100.0	95.2	% PRC_MOT_I_NOM	327.67
PRC_MOT_I_FLX_NOM	P73 - Nominal flux current	5.0	100.0	30.2	% PRC_MOT_I_NOM	327.67
T_ROTOR	P74 - Rotor time constant Tr	10	10000	200	ms	1
T_STATOR	P75 - Stator time constant Ts	0.0	50.0	9.1	ms	10
PRC_DELTA_VRS	P76 - Voltage drop due to stator resistor	1.0	25.0	2.0	% MOT_V_NOM	327.67
PRC_DELTA_VLS	P77 - Voltage drop due to leakage inductance	5.0	100.0	20.0	% MOT_V_NOM	327.67
MOT_T_NOM	Nominal motor torque			0.0	Nm	1
MOT_P_NOM	Nominal motor power			0.0	Kw	10
PRC_DEAD_TIME_CMP	P102 - Dead time compensation	0.0	100.0	22.0	‰ PRC_MOT_V_MAX	32.76
PRC_DEAD_TIME_CMP_XB	P151 - Xb = cubic coupling zone amplitude	0.0	50.0	5.0	% DRV_I_NOM	163.84
MOT_V0	P128 - Voltage motor at nominal speed with no load	0.0	100.0	100.0	% MOT_V_NOM	327.67
K_FLX45	P131 - Magnetic characteristic point 1	0.0	120.0	90.2	%	40.96
K_FLX55	P133 - Magnetic characteristic point 2	0.0	120.0	90.5	%	40.96
K_FLX65	P135 - Magnetic characteristic point 3	0.0	120.0	91.1	%	40.96
K_FLX75	P137 - Magnetic characteristic point 4	0.0	120.0	91.8	%	40.96
K_FLX82	P139 - Magnetic characteristic point 5	0.0	120.0	92.7	%	40.96
K_FLX88	P141 - Magnetic characteristic point 6	0.0	120.0	94.2	%	40.96
K_FLX93	P143 - Magnetic characteristic point 7	0.0	120.0	95.8	%	40.96
K_FLX97	P145 - Magnetic characteristic point 8	0.0	120.0	98.1	%	40.96
K_FLX100	P147 - Magnetic characteristic point 9	0.0	120.0	100.0	%	40.96
K_FLX102	P149 - Magnetic characteristic point 10	0.0	120.0	102.0	%	40.96
PRC_DELTA_VLS_TR	Voltage drop due to leakage inductance measured on Tr test	0.0	100.0		% MOT_V_NOM	163.84

2.1.5.1 Motor Auto-Tuning Parameters

These parameters are extremely important for modelling the motor correctly so that it can be used to its full potential. The best procedure for obtaining the correct values is the "**Auto-tuning test**", which is enabled with connection C42: this test must be carried out with the motor decoupled from the load. Failure to do so may invalidate the results.If the tests cannot be carried out for any reason, these values will have to estimated by reading the motor plate and following these points:

The magnetizing current value is sometimes shown on the motor plate under I_0. In this case,
P73 = I_0 / Inom motore. If this value is not available, it will have to be estimated: set P73 to a value that supplies a no-load motor running at rated speed with a three-phase alternate voltage which is effective but slightly lower than the rated motor voltage. Then change P73 until d18 displays a value of about 96 - 97% .

Once P73 is established, rated torque current P72 can be established as: $\sqrt{100^2 - P73^2}$

The rotor time constant (in seconds) can be calculated with the following formula:

$$Tr = \frac{1}{6{,}28} \cdot \frac{1}{fs} \cdot \frac{P72}{P73}$$

with fs rated slip frequency. P74 = Tr in milliseconds

Establish fs by reading the rated slip value, usually in rpm, on the motor plate, then compare it with the rated speed and multiply everything by the rated motor frequency.
Check P74 by forcing the motor to request a torque current:

- changing the speed reference value brusquely
- applying different loads to the motor

and observing the behaviour of the stator voltage module. If this value is correct, the voltage should only vary slightly in the transient phase.

These other parameters are not as important and the default values may be left if more reliable data are unavailable.
This test reads the basic electrical parameters that characterise the induction motor being used so that it can be modelled according to the rotor magnetic flux. After these values have been established, the PI regulators in the current and flux loops are self-set .

There are 4 test functions. Each requires a no-load motor, i.e. decoupled from the load, if they are to function correctly.

Connection C42 is used to enable these tests. See the table below:

C42	Enabled function
0	No test enabled
1	Only Tests 1 and 2 enabled. Motor does not need to be rotating.
2	Only Tests 3 and 4 enabled. Motor needs to be rotating.
3	All tests enabled. Tests carried out in quick succession.

The display will show the following setting:

The drive is now ready to start the test. Start reading by enabling L.I.2 with its digital input and setting C21=1 (command in series).
Once the tests have started, this setting will appear alongside:

The test finishes successfully if this setting appears the following indication and the drive does not trigger an alarm.

Now disable L.I.2 by setting its digital input to 0 or clearing C21=0.
The tests may be halted at any moment by disabling L.I.2 the drive will trigger an alarm (A7) but any results will be saved.

NB: Once C42≠0 has been set again, if **C75=0** the default values of the parameters being tested will be automatically reloaded (also speed regulator gains), on the contrary if **C75=1** remain active actual data. In order to refine data measured it's better to execute Autotuning test the first time with C75=0 and then the second time with C75=1.

2.1.5.1.1 Test 1: Reading Stator Drop and Dead Time Compensation

This test establishes the voltage drop caused by the stator resistor and the IGBT. It also estimates the signal amplitude required to compensate for the effects of the dead times so that the internal representation base of the stator voltage and the one actually generated match.
During this reading, the motor remains still in its original position and a range of flux currents are emitted. By reading the voltages and the correlated voltages the required values can be collected. This test modifies the following parameters:

Name	Description
PRC_DELTA_VRS	P76 - Voltage drop due to stator resistor
PRC_DEAD_TIME_CMP	P102 - Dead time compensation

2.1.5.1.2 Test 2: Learning the Total Leakage Induction Drop Reported to the Stator

This test establishes the voltage drop due to the total leakage inductance reported to the stator in order to calculate the proportional gain of the current loop PI.
During this test, the motor stays practically still in its original position. Flux currents in a range of values and frequencies are emitted so that by reading the voltages and correlated voltages the required values can be collected. The motor has a tendency to rotate, but this phenomenon is managed in such a way that readings are only taken when the speed is equal to zero, otherwise the results may be unreliable.
Nevertheless it is important that the motor does not rotate at a speed exceeding more than several tens of revolutions per minute. If it does, stop the test by disabling RUN and lower parameter **P129** as this is the test current used to establish ΔV_{LS}.
This test modifies the following parameters:

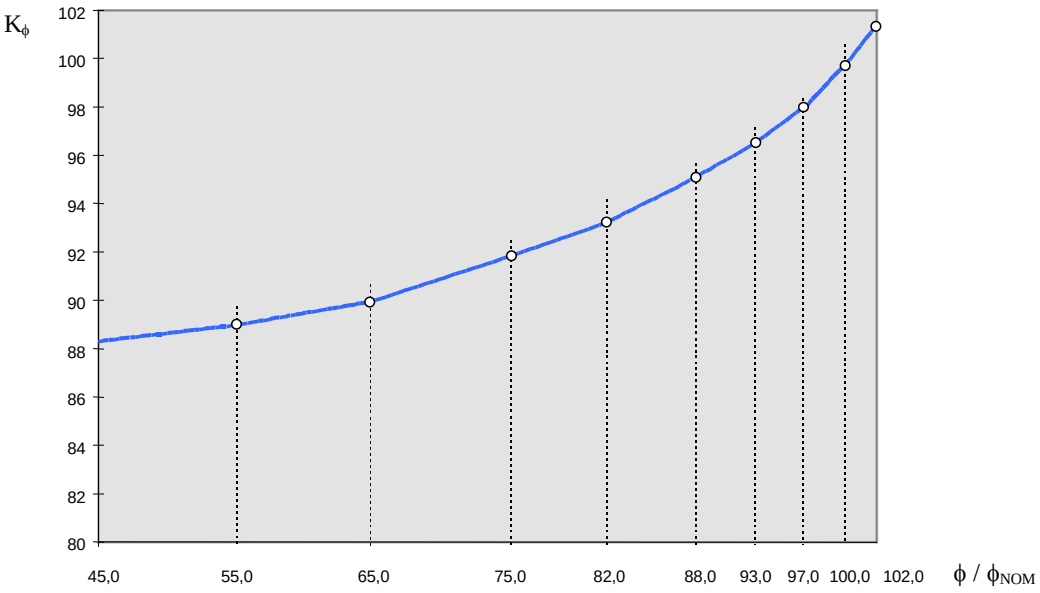
Name	Description
PRC_DELTA_VLS	P77 - Voltage drop due to leakage inductance
I_REG_KP	P83 - Kpc current regulator proportional gain

During this test the motor may start rotating, but at low speed

2.1.5.1.3 Reading the Magnetizing Current and the Magnetizing Characteristic

This test has the dual task of establishing the motor magnetizing current and reading its magnetic characteristic.
During this test, the motor is rotated at high speed (about 80% of the rated speed) and readings are taken at a range of voltages. After establishing the magnetizing value, 10 points of the magnetic characteristic are taken, after which linear interpolation is carried out in order to obtain a curve similar to the one below.

During this test the motor will rotate at a speed equal to about 80% of the rated value.



The term Kϕ is equal to:

$$\frac{Id/I\phi}{\Phi/\Phi_{NOM}}$$

i.e. it is the coefficient that when multiplied by the normalized flux in relation to the rated flux gives the normalized flux current in relation to the magnetizing current.
The characteristic is assumed to be constant for normalized fluxes under 45%.
At the end of these readings, the results will be shown in the parameters below, which may still be changed by the user.

	1	2	3	4	5	6	7	8	9	10
ϕ/ ϕNOM	45.0%	55.0%	65.0%	75.0%	82.0%	88.0%	93.0%	97.0%	100.0%	102.0%
	P131	P133	P135	P137	P139	P141	P143	P145	P147	P149
Kϕ	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

The magnetizing current may also be viewed in the parameter below:

Name	Description
PRC_MOT_I_FLX_NOM	P73 - Nominal flux current

2.1.5.1.4 Test 4: Reading the Rotor Time Costant and Estimating the Stator Time Costant

This test establishes the rotor time constant from the motor and helps to estimate the stator time constant by using data from other auto-tuning values.
During the test, the motor is rotated at the same speed as the previous test and then it goes in free revolution

During the test, the motor rotates at a speed equal to about 80% of the rated speed and is temporarily left to idle.

The following parameters are modified at the end of the test:

Name	Description
PRC_MOT_T_MAX	P41 - Maximum torque at full load
MOT_COS_PHI	P66 - Nominal power factor
T_ROTOR	P74 - Rotor time constant Tr
T_STATOR	P75 - Stator time constant Ts
MOT_T_NOM	Nominal motor torque
V_REG_KP	P80 - Kpi voltage regulator proportional gain
V_REG_TF	P82 - Tfi voltage regulator (filter) time constant
I_REG_TI	P84 - Tic current regulator lead time constant
I_REG_TF	P85 - Tfc current regulator (filter) time constant
PRC_DELTA_VLS_TR	Voltage drop due to leakage inductance measured on Tr test

“PRC_DELTAVLS_TR” is the leackage inductance measured during test 4. This value is shown only as an indication.
By the end of this test, the current and flow regulators will have been completely self-set and made compatible with the motor connected to the drive.
These readings also help estimate the Maximum motor torque (**P41**) which is important if the motor flux has to be considerably weakened.

If C75=0 the speed regulator gains are set with the default values so that the user can set the most suitable gains for the applications. The speed loop bandwidth depends heavily on the overall load inertia, thus high frequency values can only be obtained if the motor-load coupling has no elasticity or mechanical play and if the speed sensor resolution is good enough not to introduce too much noise.

Name	Description
END_SPD_REG_KP	P31 - KpV final speed regulator proportional gain
END_SPD_REG_TI	P32 - TiV final speed regulator lead time constant
END_SPD_REG_TF	P33 - TfV final speed regulator (filter) time constant

2.1.6 Speed Test

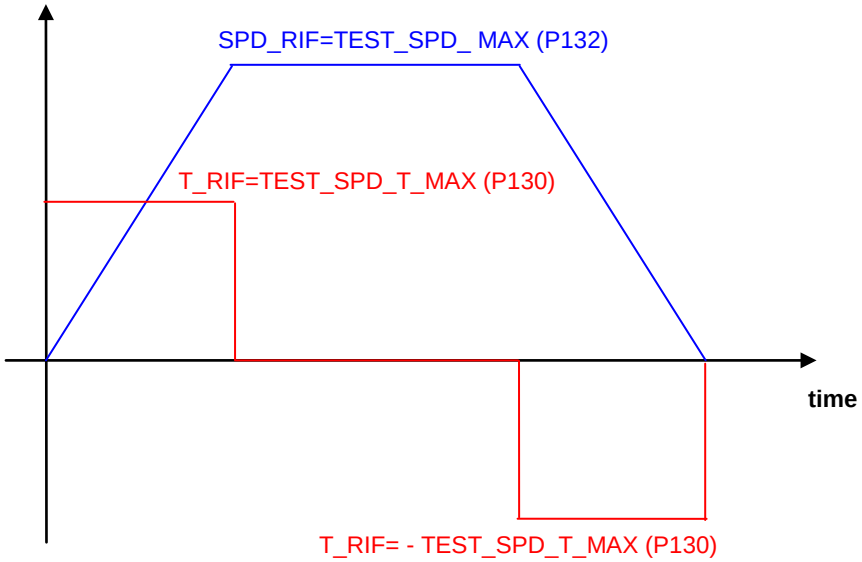
Speed test are useful for measure total system inertia and to set correctly speed regulator gains.
For safety reasons it's possible to limit maximum speed test with parameter P130, maximum motor torque with parameter P132 and maximum space admitted for test with P134 revolutions.
The drive doesn't go over these limits during test execution.

2.1.6.1 Start-Up Time

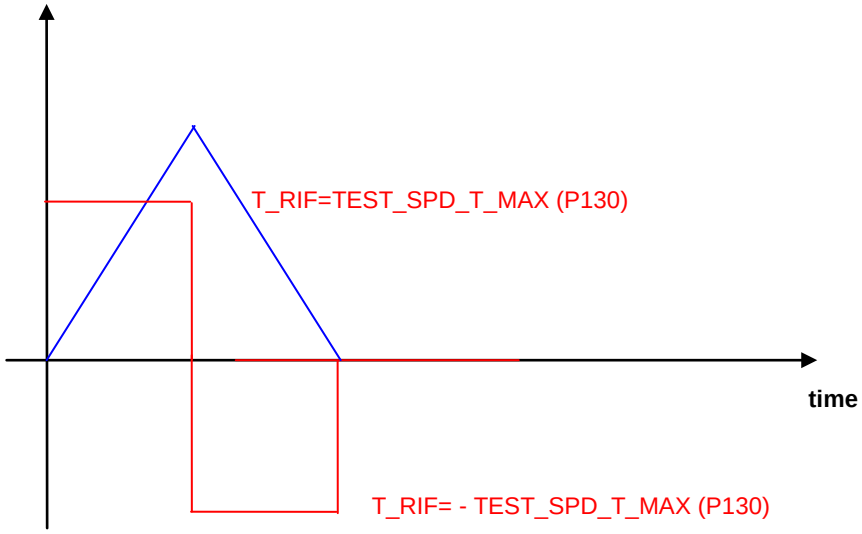
Start-up time is defined like the time needed to reach maximum speed (P65) with nominal motor torque.

This autotest is useful to measure total system inertia and frictions, for speed regulator autosetting or feed-forward compensation.
For enable this test set the utility command U01(EN_TEST_SPD) = 1 Start Up. In the display appears "Auto".
Give the L.I.2 command and automatically the motor starts to move and than return to zero speed.
At this point switch off the L.I.2 command. Parameter P169 is set with the start-up time in milliseconds, parameter P136 is set with friction measured in percent of motor nominal torque.
Automatically U01(EN_TEST_SPD) is cleared to 0 and the test is finished.

If the space admitted is enough the speed profile is trapezoidal:



Otherwise:



2.1.6.2 Step Response

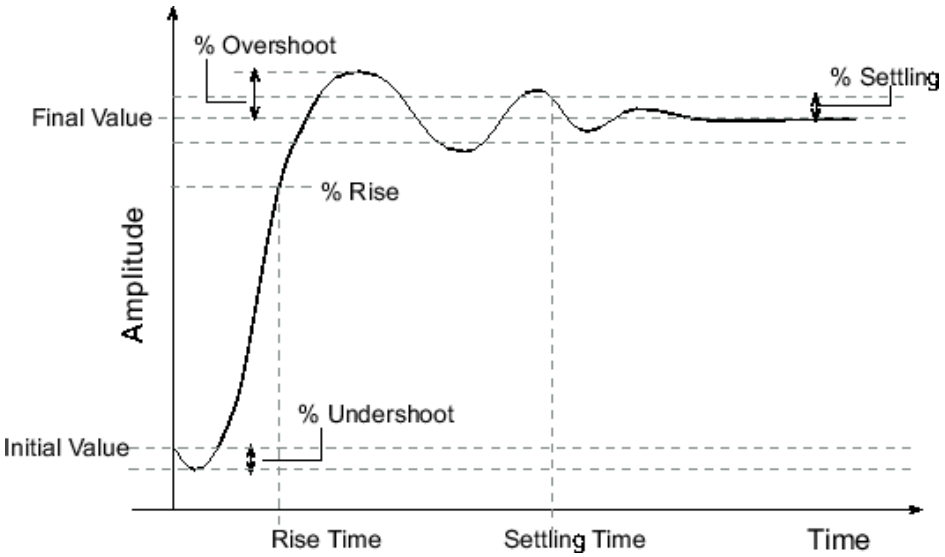
Step response is a common mode to test speed loop stability and dynamic performance.
For enable this test set U01(EN_TEST_SPD) = 2 Step. In the display appears “Auto”.
At this point all speed reference are ignored, instead a fixed speed reference is calculated equals to maximum test torque (P130) divided by speed regulator proportional gain. In this way giving this step speed reference, the torque requested doesn’t go over maximum torque admitted.
Linear ramps are automatically disabled. Giving the run command, motor starts and try to follow the reference with its dynamic performance.
Evaluating the speed response it’s possible to understand the system stability and speed loop bandwidth.
With Real Time Graph is possible to see the motor speed response. Set:

Post Trigger Points = 90%
Trigger level = 1%
Trigger Type = standard +03 Speed Reference
Trigger slope = ascending
Sample Time = 1
Channels = 2
Channel A = Standard - o03 Reference speed value after ramps
Channel B = Standard - o49 Rotation speed not filtered

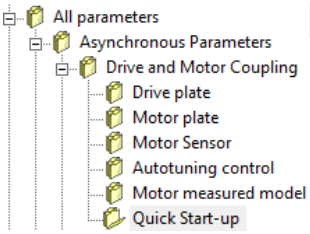
Set speed regulator gain and look the step response. Try and repeat until the speed response has good stability and bandwidth.
Motor runs at constant speed until the run command is on.
Switch off the run command to stop the motor and start a new test.
Step response test is finished only when U01(EN_TEST_SPD) is manually clear to 0.

2.1.6.2.1 Speed Regulator Gain Setting Suggestions

1. First of all disable integral part setting lead time constant P32 with a big value (> 500ms).
2. Try to find the best proportional gain P31 and filter time constant P33 to obtain a step response with max overshoot of 20%. It’s important to evaluate also the acoustic and electrical motor noise.
3. Reduce lead time constant P32 up to minimum value without increase the overshoot.



The first step for the auto-tuning procedure is the sensor test.
After to set the correct parameters in the Motor sensor section is necessary to complete the auto-tuning procedure for the sensor present and selected.

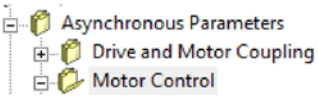


2.1.7 Quick Start-Up

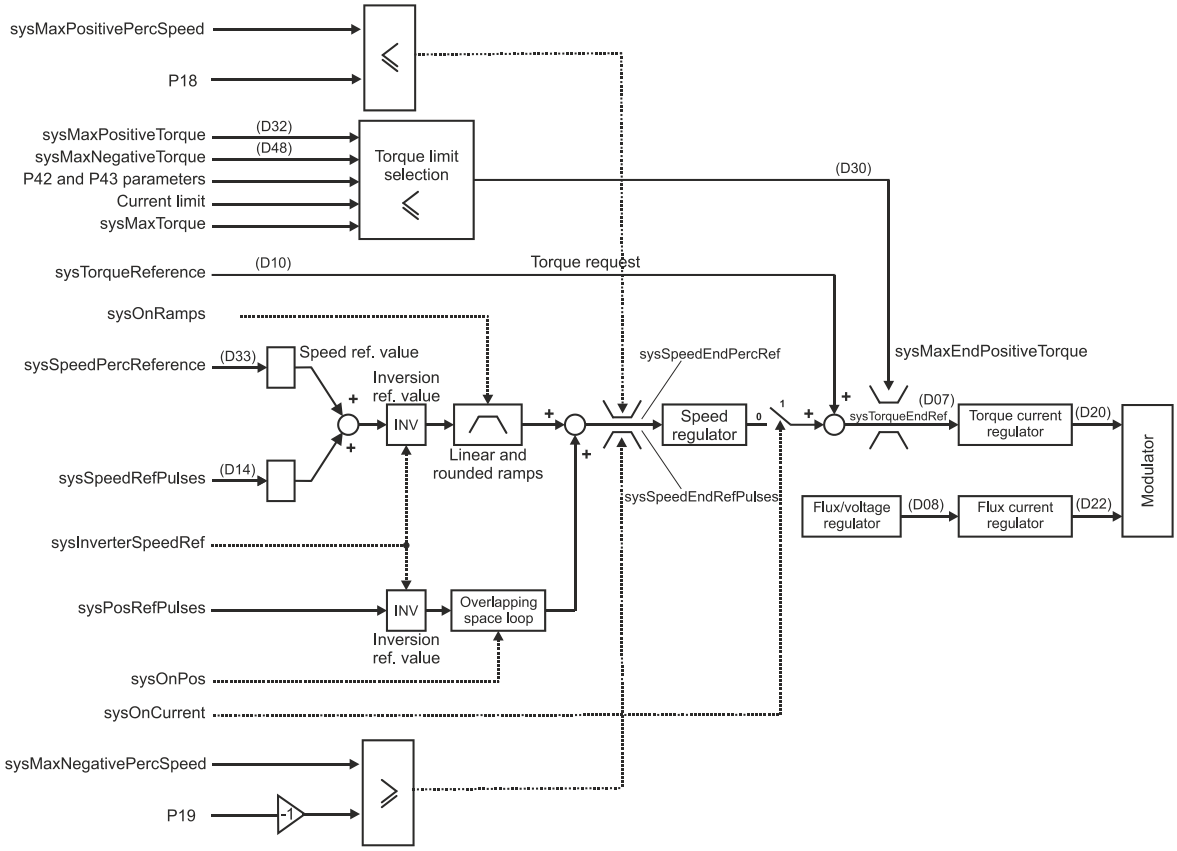
Name	Description	Min	Max	Default	UM	Scale
EN_START_UP_APPL	U05 - Enable quick start application	0	1	0		1
START_UP_SPD_SEL	U06 - Quick start application speed reference selection	0	4	0		1
PRC_START_UP_SPD_REF	P00 - Quick start application digital speed reference	-100.0	-100.0	0	% MOT_SPD_MAX	163.84
START_UP_EN_REF	U08 - Quick start application enable reference	0	1	0		1
PRC_APP_SPD_REF	D33 - Speed reference (application generated)	-100	100	0	% MOT_SPD_MAX	163.84
START_UP_RUN_SEL	U07 - Quick start application run command input selection	0	8	0		1
START_UPEN_LIN_RAMP	U09 - Quick start application linear ramps enable	0	1	0		1
SW_RUN_CMD	C21 - Run software enable	0	1	1		1

Quick start-up is used to help the user during commissioning. Enable this function setting the utility command U05=1. At that point the application present into the drive is disabled, output logical function o22 (LogicaLab application active) goes at low level and Quick start-up take the control.
With the utility command U06 is possible to select the speed reference (from analog inputs or digital parameter P00). The utility command U08 is used to enable the speed reference. The run command is given in digital way (C21) and using a physical digital input. So, with the utility command U07 it's possible to select the physical digital input necessary to give the run command and C21 is the software run command.
With U09 is possible to enable linear ramps.
Note: at the end of commissioning remember to disable Quick start-up.

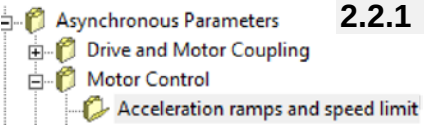
2.2 MOTOR CONTROL



The regulation system consists of a speed regulation loop and a flux or voltage regulation loop according to drive operation. These loops manage the reference values from the application and generate reference values for the internal torque and flux current loops.
All the loops are controlled by integral proportional regulators with an error signal filter and work with normalized signals so that the regulation constants are as independent as possible from the size of the motor in relation to the drive and from the system mechanics. An additional space loop that overlaps the speed loop can also be enabled.



Regulation controls speed by default; here the application manages the speed reference values, and the torque request is used as a reference value added to the speed regulator output (feed-forward).
Note that it is a torque control and not a current control, consequently during flux weakening the control automatically generates the request for the active current needed to obtain the required torque.



2.2.1 Acceleration Ramps and Speed Limit

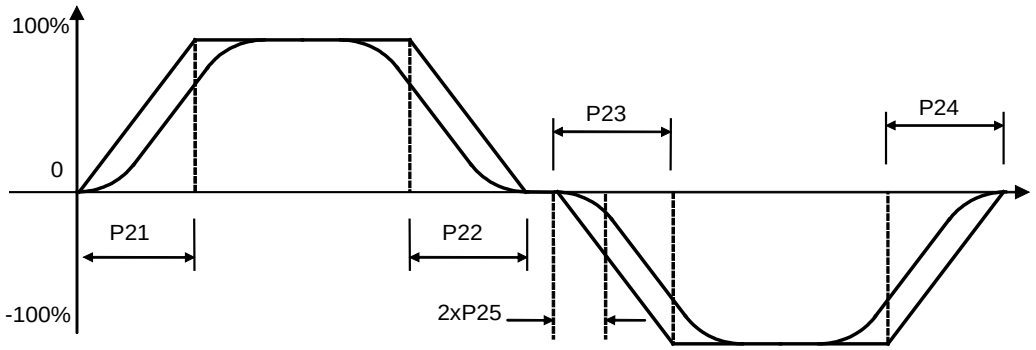
Name	Description	Min	Max	Default	UM	Scale
PRC_CW_SPD_REF_MAX	P18 - Max. CW speed reference value limit	-105.02	105.02	105.02	% MOT_SPD_MAX	163.84
PRC_CCW_SPD_REF_MAX	P19 - Max. CCW speed reference value limit	-105.02	105.02	105.02	% MOT_SPD_MAX	163.84
CW_ACC_TIME	P21 - CW acceleration time	0.01	199.99	10	s	100
CW_DEC_TIME	P22 - CW deceleration time	0.01	199.99	10	s	100
CCW_ACC_TIME	P23 - CCW acceleration time	0.01	199.99	10	s	100
CCW_DEC_TIME	P24 - CCW deceleration time	0.01	199.99	10	s	100
TF_RND_RAMP	P25 - Rounded filter time constant	0.001	10.0	0.1	s	1000
DEC_TIME_EMCY	P30 - Emergency brake deceleration time	0.01	199.99	10	s	100
EN_LIN_RAMP	E36 - Enable linear ramp	0	1	1		1
EN_RND_RAMP	C27 - Rounded ramp	0	1	0		1
EN_INV_SPD_REF	E37 - Invert reference signal software	0	1	0		1
EN_DB	C81 - Enable dead zone	Range 0 Not enable 1 Zone 1 2 Zone 2		0		1
DB1_START	P179 - Dead zone 1 initial speed	0	30000	0	rpm	1
DB1_END	P180 - Dead zone 1 final speed	0	30000	0	rpm	1
DB2_START	P181 - Dead zone 2 initial speed	0	30000	0	rpm	1
DB2_END	P182 - Dead zone 2 final speed	0	30000	0	rpm	1
PRC_TOT_APP_SPD_REF	D02 - Speed reference value before ramp	-100	100	0	% MOT_SPD_MAX	163.84
PRC_END_SPD_REF	D03 - Speed reference value after ramp	-100	100	0	% MOT_SPD_MAX	163.84
PRC_SPD_REF_MAX	D57 - Max positive speed ref			0	%MOT_SPD_MAX	163.84
PRC_SPD_REF_MIN	D58 - Max negative spd_ref			0	%MOT_SPD_MAX	163.84

In the standard application, by default (**E36=1**), the speed reference value passes across a ramp circuit that graduates its variations before it is used. Parameters **P21, P22, P23** and **P24** can be used to establish independent acceleration and deceleration slopes in both directions of movement, establishing the time required to pass from 0 to 100% in seconds. In particular (see diagram):

P21 sets the time the reference value requires to accelerate from 0 to +100%
P22 sets the time the reference value requires to decelerate from 100% to 0%
P23 sets the time the reference value requires to accelerate from 0% to -100%
P24 sets the time the reference value requires to decelerate from -100% to 0%

Setting sensitivity is 10 msec and the time must be between 0.01 and 199.99 seconds.
The default values are the same for all the parameters and are equal to 10 sec.
In the standard application, ramps can be enabled via a configurable logic input (**I22**) which works parallel to connection E36: I22=H is the same as setting E36=1. This input ensures maximum flexibility in ramp use in that the ramps are enabled only when required.
In the other application please refer to the specific documentation in order to enable the ramps.

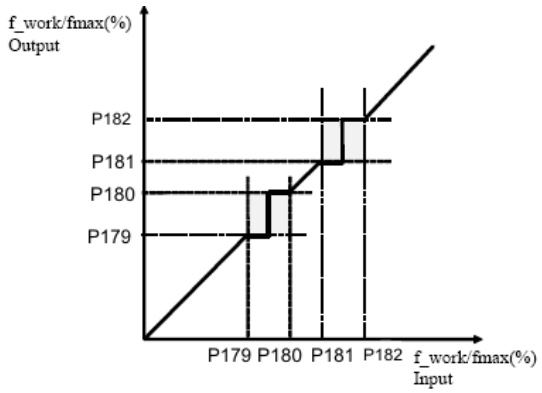
The ramp may also be rounded in the starting and finishing phases by setting **C27=1** via the rounding time set in seconds in **P25** with resolution 0.1 sec and a range from 1 to 199.9 sec. (default 10 sec).



Rounding can be enabled on its own with C27=1, which will filter the overall speed reference value only.
Some special applications may enable the linear ramps differently. See the respective instruction file for further information.

2.2.1.1 Frequency Jumps to Avoid Resonances

Using the parameters **P179**, **P180**, **P181** and **P182** it is possible to exclude, as working frequencies, all those frequencies falling within the two bands defined between P179 – P180 and P181 – P182, where P179, P77, P78 and P182 are expressed as % of the maximum working frequency (see diagram)



Wherever exclusion bands are pre-set the drive behaves in the following way:
If the set frequency reference falls within the exclusion band it is maintained at the lower value of the band, if the set value is less than the mid band value, while if the value is greater than the mid band value it assumes the upper value.
In a transitional phase however the system passes through all of the band's frequencies (ramp). The use or otherwise of the exclusion bands requires the setting of the corresponding connection **C81**:
C81=0 no band
C81=1 Band 1 (P179-P180)
C81=2 Band 1 (P179-P180) and Band 2 (P181-P182)

For example if the working fmax = 50Hz and the plant presents two resonance frequencies which are quite clear at 45Hz and 35Hz the frequencies between 43 - 47 Hz and 33 - 37 Hz could be excluded setting

P179 = (33/50)* 100.0 = 66.0%
P180 = (37/50)* 100.0 = 74.0%
First band

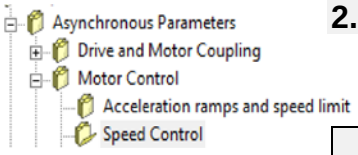
P181 = (43/50)* 100.0 = 86.0%
P182 = (47/50)* 100.0 = 94.0%
Second band

C81=2 Enables both exclusion bands

2.2.2 Speed Limit

Speed limits are usually set by parameters P18 and P19 but it's possible also enable analog limits. In the standard application AI1, AI2, AI3 or AI16 can be configured like positive, negative or symmetrical speed limit. In this case will be active the lower speed limit between digital and analog values.

2.2.3 Speed Control



Name	Description	Min	Max	Default	UM	Scale
END_SPD_REG_KP	P31 - KpV final speed regulator proportional gain	0.1	400.0	4		10
END_SPD_REG_TI	P32 - TiV final speed regulator lead time constant	0.1	3000.0	80	ms	10
END_SPD_REG_TF	P33 - TfV final speed regulator (filter) time constant	0.0	25.0	0.8	ms	10
EN_TF2_SPD_REG	C69 - Enable 2nd order filter on speed regulator	0	1	0		1
START_SPD_REG_TF	P34 - TfV initial speed regulator (filter) time constant	0.0	25.0	0.8	ms	10
PRC_SPD_THR_GAIN_CHG	P44 - End speed for speed PI gain change	0.0	100.0	0	% MOT_SPD_MAX	163.84
START_SPD_REG_KP	P45 - KpV initial speed PI proportional gain	0.1	400.0	4		10
START_SPD_REG_TI	P46 - TiV initial speed PI lead time constant	0.1	3000.0	80	ms	10
EN_SPD_REG_MEM_CORR	C77 - Enable PI speed gains compenstation	0	1	0		1
EN_SPD_REG_D	C72 - Enable feedforward	0	1	0		1
SPD_REG_KD_TF2	P168 - Second order feedforward filter	0.0	1000.0	0.0	ms	10
NOTCH_FREQ	P54 - Notch nominal frequency	0.0	2000.0	0	Hz	10
NOTCH_BW	P55 - Notch bandwidth	0.0	3000.0	0	Hz	10
NOTCH_DEEP	C92 - Notch filter deep	0	1	0.1		100
NOTCH_RID	C93 - Notch filter reduction	0	1	1.0		100
PRC_MOT_SPD_MAX	P51 - Maximum speed for alarm	0.0	125.0	120.0	% MOT_SPD_MAX	163.84
PRC_LSE_CTR_MAX_ERR	P56 - Max speed error	0.1	200.0	200.0	% MOT_SPD_MAX	40.96
PRC_END_SPD_REF	D03 - Speed reference value after ramp	-100	100	0	% MOT_SPD_MAX	163.84
PRC_MOT_SPD	D04 - Speed reading	-100	100	0	% MOT_SPD_MAX	163.84
PRC_T_REF	D05 - Torque request	-100	100	0	% MOT_T_NOM	40.96
MOT_SPD	D21 - Motor rotation speed			0	rpm	1
SB_MOT_SPD_MAX	E27 - Second bank Max. operating speed	50	30000	3000	rpm	1
SB_SPD_REG_KP	E28 - Second bank KpV speed regulator proportional gain	0.1	400.0	6		10
SB_SPD_REG_TI	E29 - Second bank TiV speed regulator lead time costant	0.1	3000.0	30	ms	10
SB_SPD_REG_TF	E30 - Second bank TfV speed regulator (filter) time costant	0.0	25.0	0.4	ms	10
SB_CW_ACC_TIME	E31 - Second bank CW acceleration time	0.01	199.99	10	s	100
SB_CW_DEC_TIME	E32 - Second bank CW deceleration time	0.01	199.99	10	s	100
SB_CCW_ACC_TIME	E33 - Second bank CCW acceleration time	0.01	199.99	10	s	100
SB_CW_DEC_TIME	E34 - Second bank CCW deceleration time	0.01	199.99	10	s	100
SB_ON	E35 - Second bank active	0	1	0		1
SPD_REG_SETTING	U02 - Speed regulator autosetting	0	4	0		1
SPD_LOOP_BW	P20 - Speed loop bandwidth	0.1	200.0	5.0	Hz	10.0
SPD_LOOP_BWL_MAX	Max speed loop bandwidth	0.1	200.0		Hz	

2.2.3.1 Managing Speed Reference Values

The application generates two speed reference values:

- One , sysSpeedReference, is a percentage of the maximum speed (set in parameter P65) displayed in internal value d33 and on monitor o41.
- The other, sysSpeedRefPulses is pulses for a period of PWM. This particular reference is used so as not to be lose any pulses if the frequency input is used. Default internal normalization is done with 65536 pulses per mechanical revolution, but it's possible to enable high revolution (32 bits per turn) by application. Standard application 0.24 works with 32 bits.

After these two reference values have been processed they are added together in order to obtain the total speed reference value.

2.2.3.2 Inverting and Limiting Speed Reference Values

In the standard application, logic function **I12** "**Speed reference value inversion**", which is assigned to an input (the default is L.I.6 pin2-M3), or connection **E37** are used to invert the reference value according to the following logic (OR-exclusive):

I12 = 0 E37 = 0	Reference value not inverted (default values)
I12 = 1 E37 = 0	Reference value inverted
I12 = 0 E37 = 1	Reference value inverted
I12 = 1 E37 = 1	Reference value not inverted

The reference value is inverted before the ramp thus, if the ramp is not disabled, the direction of rotation changes gradually (default E37=0 and I12=0).
There is another chance, to invert positive speed rotation setting C76=1.
Enabling this function, with the same speed reference and speed measured, the motor rotates in reverse direction.
Parameters P18 and P19 are used to limit the total reference value within a range set between these two values; P18 is the maximum limit (positive speed) and P19 is the minimum limit (negative speed). These two parameters may be set at a range from ±105%, thus special settings may be used to limit operation within the 2 quadrants or within just one quadrant.

The following settings are provided by way of example:

P18 = 100.0%	P19 = 100.0%	-100.0% < speed reference value < 100%
P18 = 30.0%	P19 = 20.0%	-20.0% < speed reference value < 30%
P18 = 80.0%	P19 = -20.0%	20.0% < speed reference value < 80.0%
P18 = -30.0%	P19 = 60.0%	-60.0% < speed reference value < -30.0%
P18 = 0%	P19= 100.0%	speed reference value only negative
P18 = 100.0%	P19= 0%	speed reference value only positive

2.2.3.3 Speed Control Alarms

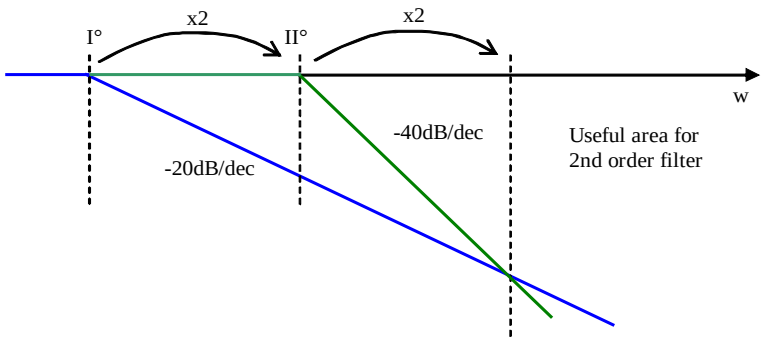
Starting from 12.00 software revision is available a new alarm **A.9.6** if the drive loses the speed control. This alarm is activated if:

- speed reference and actual speed goes in opposite direction
- the error between speed reference and actual speed is greater than parameter P56 "PRC_LSE_CTR_MAX_ERR". P56 default value is 200%of max speed so the alarm is disabled. When sensorless control is enabled, automatically P56 goes to 10%.

This control is disabled during " Start-up time autotuning").
Moreover there is another alarm **A.9.2** that is activated if the speed is greater than P51 "PRC_MOT_SPD_MAX".

2.2.3.4 2nd Order Speed Regulator Filter

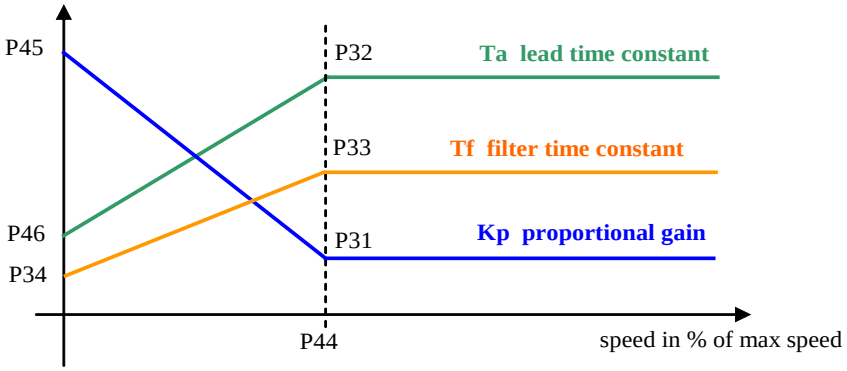
The speed regulator filter can be changed by using a 2nd order one.
To enable this function set **C69=1**. Parameter **P33** will always set the filter time constant in milliseconds, and thus its natural pulsation, given that internal damping is always set to 0.8 so that the filter is quick to respond but does not overshoot.
Note that enabling a 2nd order filter means reducing the margin of system stability, hence the filter time constant value must be thought through carefully before setting so as not to create instability:



By taking as reference the 1st order filter time constant tolerated by the system, the 2nd order filter has to be set to double frequency (half time) so that it has the same phase margin.
The effects of the 2nd order filter will be better than the 1st order filter only when the frequency is double that of the 2nd order filter.
Example: if a 1st order filter with a time constant P33=0.8 ms passes to a 2nd order filter, P33=0.4 ms has to be set to have the same stability margin.

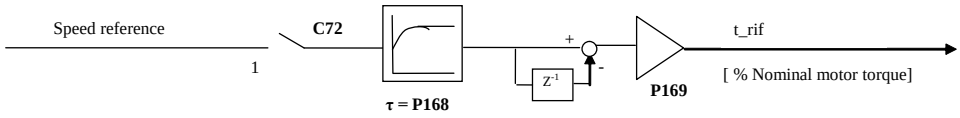
2.2.3.5 Variable Speed Regulator Gains

Speed regulator gains can be varied according to actual speed: **P45** is the proportional gain at zero speed, **P46** is the initial lead time constant and P34 is the initial filter time constant. Setting **P44** (a percentage of the maximum speed) with the end variation gain speed establishes a linear gain variation that ranges from the initial values (P45,P46 and P34) to the final values in P31,P32,P33. Setting P44=0.0 disables this function so that the gains set in P31, P32 and P33 are used.



2.2.3.6 Torque Feed-Forward on Speed Reference

It's possible to enable the Torque feed-forward on speed reference using **C72** connection:
It' possible to estimate the torque reference needing for the speed variation requested with the speed reference derivative using a II° order filter (time constant in **P168** in ms) and taking account of total inertia (setting parameter P169 Startup time).

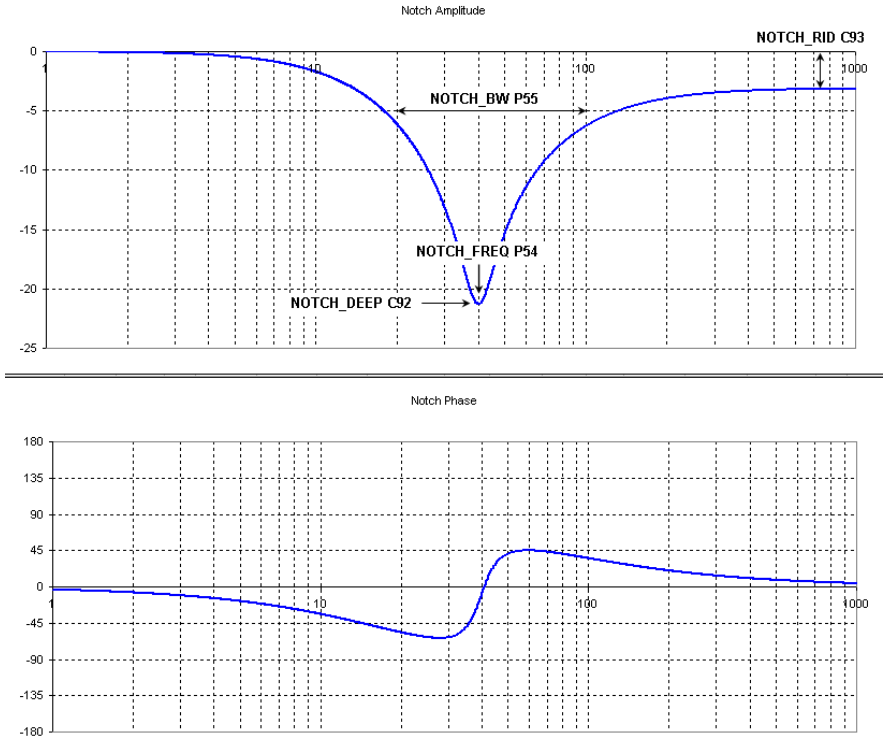


The Startup time is the time necessary for motor and load to reach the maximum speed (set in P65) with the nominal motor torque. This data has to be set in milliseconds in parameter P169.
It's useful to set some milliseconds of filter (P168) on order to avoid too much noise on torque reference for the time derivative.
When it's enabled this function the torque reference produced is added to the speed regulator output.
The torque feed-forward can be very useful in the servo-drive application when the target is to follow very promptly the speed reference, because it increases the bandwidth without using high gains on speed regulator.
Note1: torque feed-forward isn't appropriate in load variable inertia applications.

2.2.3.7 Notch Filter

Starting from 12.00 revision it's possible to enable a notch filter that works between speed regulator and current loop. The Notch Filter is implemented in the control system to reduce the effect of the mechanical resonances of the plant, that usually limits the speed bandwidth.
To configure the filter are available four parameters: **P54, P55, C92, C93**.
The NOTCH_FREQ (P54) is the center filter frequency, the NOTCH_BW (P55) is the filter bandwidth, the NOTCH_DEEP (C92) is the filter amplitude and the NOTCH_RID (C93) is the different filter gain over filter bandwidth.

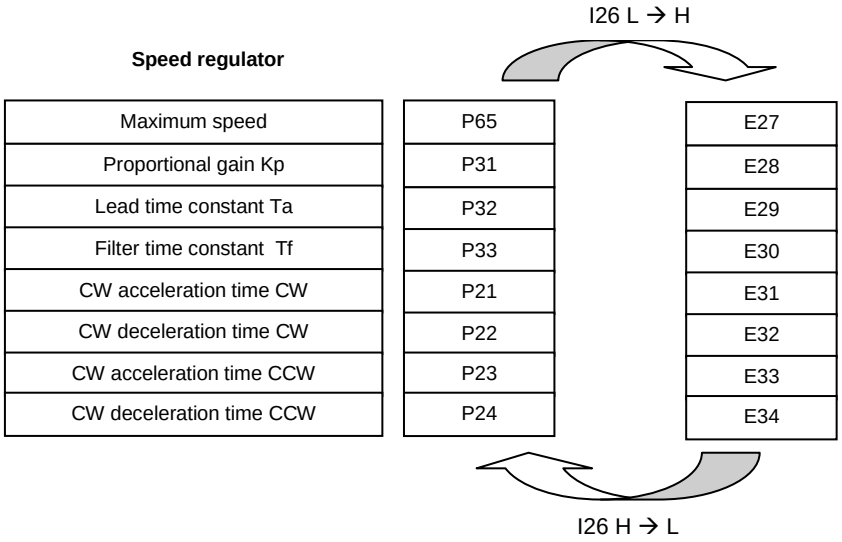
In order to enable the Notch filter is enough to set the NOTCH_FREQ (P54) different from zero.
To easy use of this filter is possible to set NOTCH_FREQ=NOTCH_BW=frequency to remove and leave the other two parameters to its default value, NOTCH_DEEP=0.10 and NOTCH_RID=1.00 (no reduction).



2.2.3.8 Speed Regulator Second Bank

In the standard application, this function is used to change on-line the speed regulator parameters (P31÷P33), the maximum speed (P65) and the linear ramps acceleration times (P21÷P24), to achieve a good reference resolution, working at low speed.

For enable the second parameters bank (E27÷E34) it's necessary to set the parameter **E35=1**, otherwise to bring at high level the logical function **I26** using one of the 8 logical inputs.
When the function is activated the standard data (P31÷P33, P65 and P21÷P24) are automatically exchanged with the second bank (E27÷E34) and the connection E35 is set to 1.
The exchange will be executed only if the working speed is lower than the new maximum speed, this is useful to avoid the over speed alarm A.9.2.H.



If the speed is greater than new maximum speed, the activation command is ignored.
If the speed ramps are active your value will be automatically calculated to avoid sharp transitory.

The parameter E35 keep memory of second parameters bank activation.
When the drive is switched on, the parameter E35 and the logical input I26 are tested: if there is coherence no action is taken, otherwise the parameter E35 is automatically changed to line up with logical input I26 and the data are exchanged.

When the function is disabled, bringing I26 to low level or clearing E35=0, data are automatically exchanged, with initial value restore.

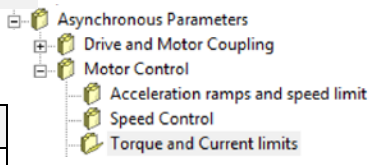
2.2.3.9 Speed Regulator Autosetting

In order to use this function is necessary to measure the start-up time (P169), one way is execute "Start-up time" test (see par 2.1.6.1), for. At that point is possible to enable speed regulator auto-setting with parameter "SPD_REG_SETTING".

	Description	**Limitation**
0 – **No**		
1 – **Stable**	speed loop bandwidth 2.5 Hz	P31 < 50
2 – **Dynamic**	speed loop bandwidth 20 Hz	P31 < 50
3 – **Max**	speed loop corresponding to P31=50	speed loop bandwidth < current loop bandwidth/4
4 – **Manual**	with this selection it's possible to set manually, with parameter **P20** [Hz], the speed loop bandwidth	P31 < 100 and speed loop bandwidth < current loop bandwidth/4

If "SPD_REG_SETTING" is ≠ 0, automatically are changed speed regulator gains P31,P32,P33 and than SPD_REG_SETTING" is cleared to 0.
With every selection the second order filter is enabled and variable gains disabled.
The "SPD_LOOP_BW_MAX" internal value show the max speed bandwidth admitted with the actual current bandwidth and sensor used.

2.2.4 Torque and Current Limits

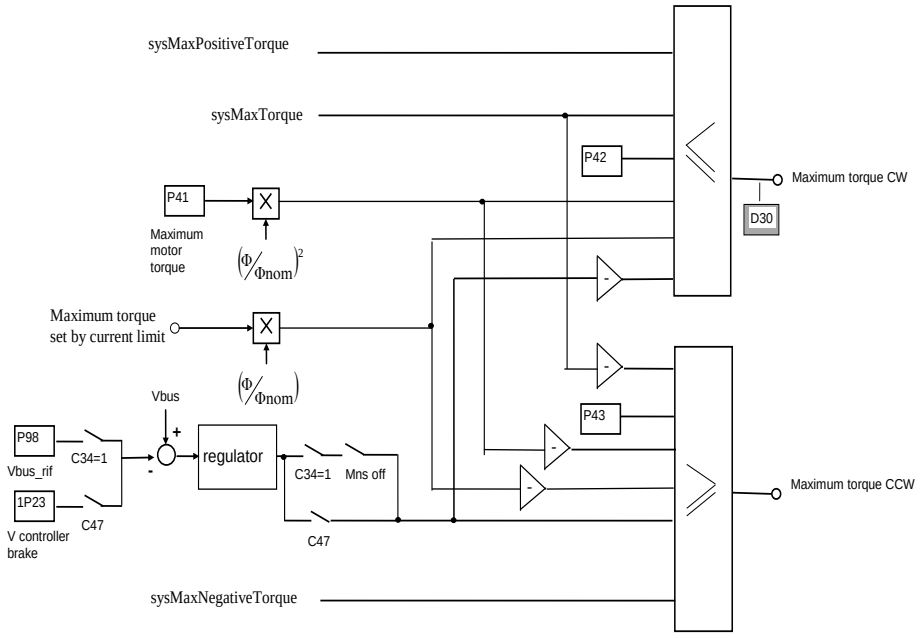


Name	Description	Min	Max	Default	UM	Scale
PRC_DRV_I_PEAK	P40 - Current limit	0.0	250.0	200	% DRV_I_NOM	40.96
PRC_DRV_CW_T_MAX	P42 - Maximum torque in the positive direction of rotation	0.0	400.0	400.0	% MON_T_NOM	40.96
PRC_DRV_CCW_T_MAX	P43 - Maximum torque in the negative direction of rotation	-400.0	-0.0	-400.0	% MOM_T_NOM	40.96
PRC_DRV_T_MAX	D30 - Maximum torque	-100	100	0	% MOT_T_NOM	40.96
PRC_DRV_I_T_MAX	D31 - Maximum torque by current limit	-100	100	0	% MOT_T_NOM	40.96
PRC_DRV_I_MAX	D29 - Current limit	-100	100	0	% DRV_I_NOM	40.96

2.2.4.1 Choosing the Active Torque Limit

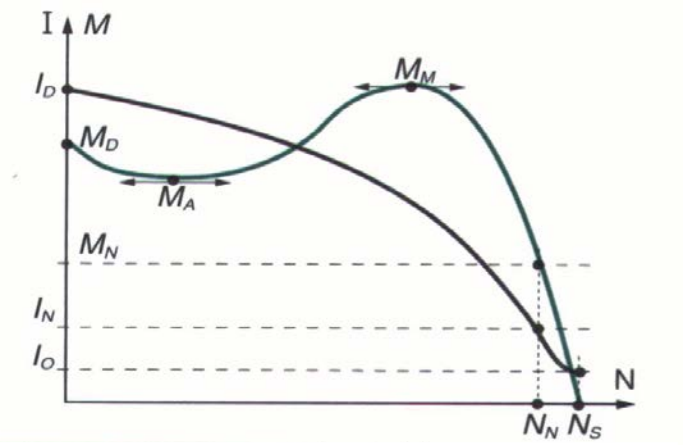
The positive and negative torque limits are chosen to restrict the following values:

- P42 / P43 = maximum torque, in both directions according to rated torque;
- Maximum torque linked to maximum motor torque according to the rated torque (parameter **P41**);
- Maximum torque set by the current limit;
- Maximum torque limit reference value generated by the application: sysMaxTorque (symmetrical), sysMaxPositiveTorque and sysMaxNegativeTorque (asymmetrical)
- Maximum torque limited by the regulator output in order to back up the bus voltage should the mains fail;
- Maximum torque controlled in the startup phase with the motor magnetized;
- Maximum torque limited in the controlled braking phase (as long as this function is enabled by setting **C47=1**).



2.2.4.2 Maximum Motor Torque Limit

The induction motor has a maximum torque that depends on its construction characteristics.
The graph below illustrates the progress of a torque curve according to speed with the motor powered by a constant frequency (Ns). The same graph can also be referred to when an inverter is used, reading it as torque delivered according to slip, i.e. the difference between the rotation speed of the electrical values and the rotor (Ns – N in the graph).



Id = starting current

In = rated current
Io = no-load current

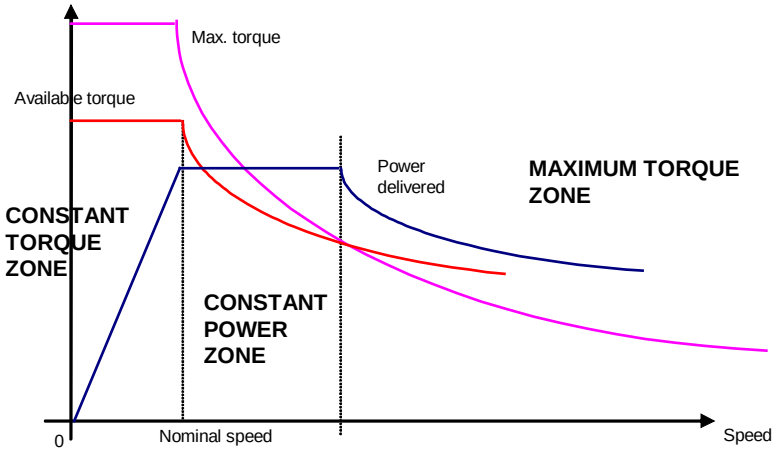
Md = starting torque
Ma = acceleration torque
Mm = max. torque
Mn = rated torque

Nn = rated speed
Ns = synchronism speed

3-phase induction motor torque (M) and current (I) curve according to number of revolutions (N).

The graph illustrates how the delivered torque increases according to slip up to a certain point represented by the maximum motor torque. If the maximum torque is exceeded, control is lost in that the torque decreases even when the current is increased.
It is proved that the maximum motor torque decreases during flux weakening in proportion to the square of the ϕ/ϕnom ratio. Thus the motor has three working areas:

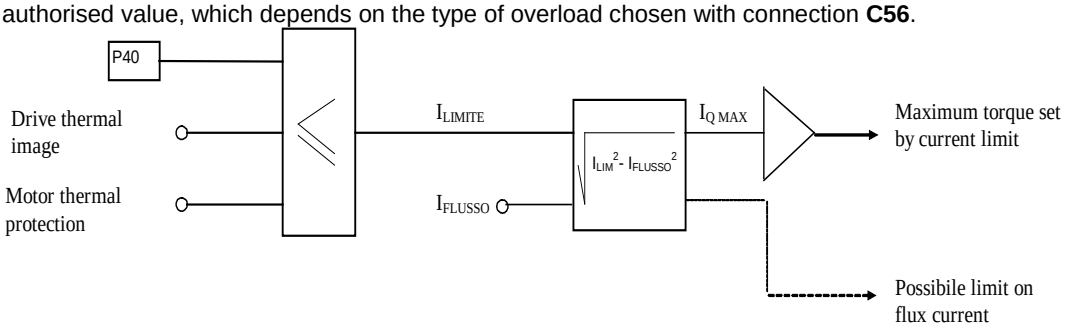
- **Constant torque**: the maximum torque is available up to the rated speed (as long as the current to deliver it is available);
- **Constant power**: over the rated speed, flux is reduced proportionally to speed, the available torque also drops in proportion to speed, the power delivered is constant;
- **Maximum torque**: after reaching the maximum torque, which decreases with the square of the speed, the available torque will start to drop with the square of the speed and the power delivered will decrease in proportion to the speed.



To ensure regulation stability, **P41** must be set with the Maximum torque divided by Rated motor torque. This limit will decrease during flux weakening with the square of the speed.

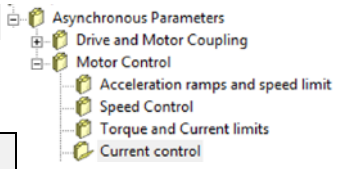
2.2.4.3 Maximum Current Limit

The drive is fitted with a maximum current limiting circuit that cuts in if exceeded, restricting the maximum current delivered to the lowest value from among parameter **P40,** the value calculated by the drive thermal image circuit, and the motor thermal protection circuit.
P40 is used to programme the maximum current limit delivered by the drive from 0% to the maximum authorised value, which depends on the type of overload chosen with connection **C56**.



If the current limit exceeds the flux current, then only the torque current will be limited and thus the maximum torque delivered is limited. Otherwise, the delivered torque is set to zero and the flux current is also limited

2.2.5 Current Control



Name	Description	Min	Max	Default	UM	Scale
EN_I_CNTRL	E38 - Enable only current control	0	1	0		1
EN_I_FF	E49 - Enable feed-forward torque reference in speed control	0	1	0		1
EN_I_CNTRL_SPD_LIM	C39 - Enable speed limitation in current control	0	1	0		1
I_REG_KP	P83 - Kpc current regulator proportional gain	0.1	100.0	2.6		10
I_REG_TI	P84 - Tic current regulator lead time constant	0.0	1000.0	9.1	ms	10
I_REG_TF	P85 - Tfc current regulator (filter) time constant	0.0	25.0	0	ms	10
PRC_I_REG_KP_COEFF	P126 - KpI Corrective coeff. estimated Kp for current loops	0.0	200.0	100	%	40.96
I_LOOP_BAND	Current loop bandwidth			0	Hz	1
PRC_I_DECOUP	P158 - Corrective coefficient for decoupling terms	0.0	200.0	50.0	%	40.96
DIS_I_DECOUP	C59 - Disable dynamic decoupling + feedfoward	0	1	0		1
I_DELAY_COMP	P160 - PWM delay compensation on the currents	-800.0	800.0	40	% TPWM	40.96
PRC_IQ_REF	D07 - Request torque current Iq rif	-100	100	0	% DRV_I_NOM	40.96
PRC_ID_REF	D08 - Request magnetizing current Id rif	-100	100	0	% DRV_I_NOM	40.96
PRC_IQ	D15 - Current torque component	-100	100	0	% DRV_I_NOM	40.96
PRC_ID	D16 - Current magnetizing component	-100	100	0	% DRV_I_NOM	40.96
PRC_VQ_REF	D20 - Vq rif	-100	100	0	% MOT_V_NOM	40.96
PRC_VD_REF	D22 - Vd rif	-100	100	0	% MOT_V_NOM	40.96
MOT_I	D11 - Current module			0	A rms	16
EL_FRQ	D13 - Rotor flux frequency			0	Hz	16
ACTV_POW	D01 - Active power delivered			0	kW	16
PRC_MOT_T	D35 - Actual torque produced	-400	400	0	% MOT_T_NOM	40.96

Current regulators generate the voltage reference values required to ensure torque and flux currents that are equal to their reference values.
The current signals processed by these regulators are expressed according to the maximum drive current, which means that they are affected by the ratio between the rated motor current and the rated drive current (P61). To ensure good control, this ratio should not drop below 35 - 40% i.e. Do not use a drive that is more than two and a half times larger than the motor, nor a motor that is more than one and a half times larger than the drive.
The flux current is displayed as a percentage of the rated motor current in d16, while the torque current is displayed as a percentage of the rated motor current in d15. The constants of these regulators are established in engineering units by parameters **P83**, proportional gain Kp; **P84**, time in ms of the lead time constant Ta equal to the integral regulator time constant multiplied by the gain (Ta = Ti*Kp); and **P85**, filter constant in ms.

Parameters P83 and P84 cannot be changed directly because they are considered to be perfectly calculated by the auto-tuning. P83 can only be changed by accessing BLU reserved parameter P126 "Multiplication coefficient Kp and current loop"

There is dynamic decoupling between the direct axis and the orthogonal axis with a low default gain. Should there be any doubts as to whether the dynamic decoupling is working properly, then it can be disabled by setting **C59=1**.

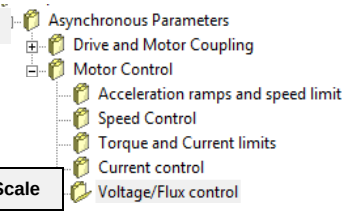
2.2.6 Drive Torque Control

In the standard application is possible to enable only torque control with parameter P238 or digital input function I01 ("Torque control"). In that case speed regulator is disabled and torque refernce is taken from analog or digital signals (see standard application).

Working in torque control are possible two different approach:

- Torque control with speed limit: setting C39=1 (EN_ICNTRLSPD-LIN) enable the speed limitation with the speed regulator when limits are reached.
- Torque control with soft switch to speed control: clearing C39=0 (EN_ICNTRLSPD_LIM) disable the speed limitation but enable the soft switch with speed control. If on-line torque control is disabled, speed regulator starts its torque demand from last torque request.
  In order to enable torque feed-forward set E49=1.

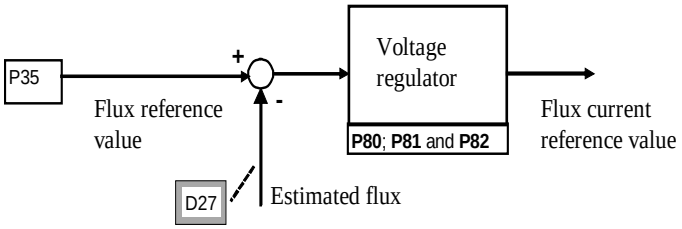
2.2.7 Voltage/Flux Control



Name	Description	Min	Max	Default	UM	Scale
MOT_WAIT_DEMAGN	P28 - Motor demagnetization waiting time	0	3000	0	ms	1
MOT_WAIT_MAGN	P29 - Motor magnetization waiting time	50	3000	300	ms	1
MAGN_SEL	C38 - Motor Magnetization selection	0	2	0		1
PRC_FLX_REF	P35 - Flux Reference	0.0	120.0	100	% MOT_FLX_NOM	40.96
V_REF_COEFF	P36 - Kv Max operating voltage multiply factor	0.0	100.0	100		327.67
PRC_FLX_MIN	P52 - Minimum Flux admitted	0.0	100.0	2	% MOT_FLX_NOM	40.96
V_REG_KP	P80 - Kpi voltage regulator proportional gain	0.1	100.0	10.0		10
VF_V_REG_TA	P81 - V/f Ti voltage regulator lead time constant	0.0	1000.0	20.0	ms	10
V_REG_TF	P82 - Tfi voltage regulator (filter) time constant	0.0	1000.0	12.0	ms	10
MOD_INDEX_MAX	P122 - Max. modulation index	0.500	0.995	0.98		1000
PRC_V_REF_DCBUS	P125 - Voltage reference function of DC bus	0.0	100.0	96.00513	%	327.67
PRC_V_REG_KP_COEFF	P127 - KpV Corrective coeff. estimated Kp for voltage loops	0.0	798.0	100	%	40.96
V_DELAY_COMP	P161 - PWM delay compensation on the voltages	-800.0	800.2	125.0	% TPWM	40.96
EN_ENERGY_SAVE	C86 - Enable energy saving	0	1	0		1
TI_ENERGY_SAVE	P188 - Energy saving regulator filter time constant	100	2000	100	ms	1
PRC_FLX_MIN_ENERGY	P189 - Energy saving admissible minimum flux	0.0	100.0	20.0	% MOT_FLX_NOM	40.96
V_REF	D09 - Voltage reference value at max. rev.	-100	100	0	% MOT_V_NOM	40.96
MOT_V	D17 - Stator voltage reference value module			0	V rms	16
PRC_MOT_V	D18 - Stator voltage reference value module	-100	100	0	% MOT_V_NOM	40.96
MOD_INDEX	D19 - Modulation index	-100	100	0		40.96
MOT_FLX	D27 - Motor Flux			0	% MOT_FLX_NOM	40.96

The flux regulator generates the request for the flux current required to maintain the magnetic rotor flux equal to the reference value set in parameter **P35** when the working area is with **Constant torque.**

Constant torque working area

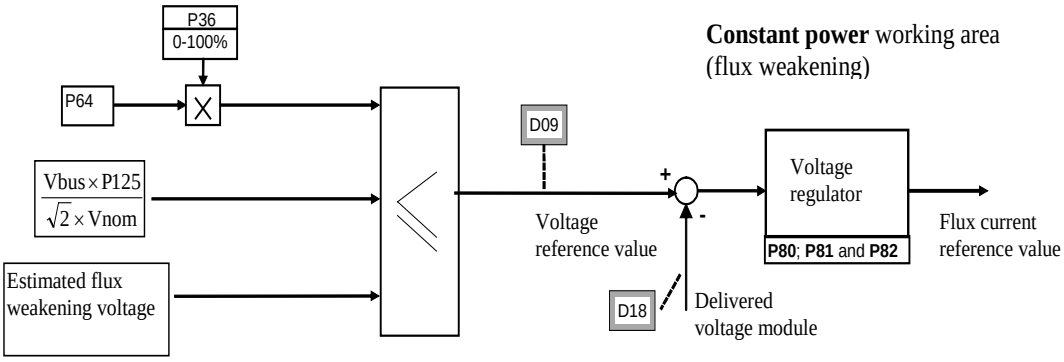


When operating with **Constant Power** the regulator generates a request for the flux current required to ensure the stator voltage module is the same as the voltage reference value and thus to weaken the flux gradually as the speed increases.

The active voltage reference value (displayed in d09) is always the smallest of the three values, which are all normalized in relation to the rated motor voltage (**P62**):

Parameter **P64** "Maximum operating voltage" multiplied by coefficient **P36;**
A term linked to the direct bus voltage with a margin set with **P125** (default 96%), because the maximum stator voltage that can be delivered may not exceed the direct voltage divided by √2;

A term linked to the estimated stator voltage to be applied during flux weakening based on the required current so that there is a margin with regard to the maximum voltage available and thus to be better equipped to deal with variations in the required torque



The flux current is normalized in relation to the magnetizing current (P73), the rotor flux is normalized in relation to the rated flux and is displayed as a percentage in d27. The stator voltage module is normalized in relation to the rated motor voltage (P62) and is displayed as a percentage in d18 and as a value in Volt rms in d17
The constants of this regulator are established in engineering units by parameters **P80**, proportional gain Kp; **P81**, time in ms of the lead time constant Ta equal to the integral regulator time constant multiplied by the gain (Ta = Ti*Kp); and **P82**, filter constant in ms.

Parameters P80 and P81 cannot be changed directly because they are considered to be perfectly calculated by the auto-tuning.

They can only be changed by accessing BLU reserved parameter **P127** "Multiplication coefficient Kp and Ta flux loop"
The voltage/flux regulator limit is normally set at ± rated motor current so that the total flux may be changed quickly during the transient state.
If the estimated flux drops below 5% of the rated flux, the lower voltage regulator limit is brought to a value that will generate a flux of at least 4%. This is done so as not to lose control in a zone where the flux has been weakened widely.

2.2.7.1 Energy Saving

This function, if enabled with **"EN_ENERGY_SAVE"** C86=1, allows an energy saving with an automatic current reduction matched to the load, reducing the conduction loss (proportional to the current square value). The basic idea is to find the best subdivision between active and reactive current, because the first is proportional to the torque current, the second to the magnetic field produced.
With reduced working load it's better to reduce the magnetic field under its nominal value and increase the torque current.
The energy saving is significant especially for motors with low cos φ and for load lower than 40-50% of nominal value, for load much great of this the saving is negligible.
When the Energy Saving is enabled the dynamic performances decreases also if it's always guarantee a good stability in every working area.

2.2.7.2 Start-Up With a Motor Magnetized

C38 provides 2 different ways for starting up the motor:

C38=0	Standard operation	When RUN is enabled, the machine is magnetized with the maximum delivered torque at zero for a time equal to P29. The flux is then checked to see whether it exceeds the minimum (P52). If it does, the torque is "freed", if it does not the drive triggers alarm A2 "Machine not magnetized".
C38=2	Machine always magnetized	The machine is always magnetized. If the flux drops below the minimum value (P52) the drive triggers alarm A2. If the drive is ready, the motor will start up as soon as the Run command is enabled.

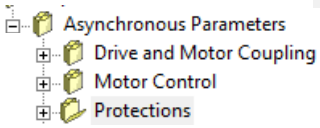
When the machine is magnetized, it means that the motor is powered and that a current equal to the magnetizing current is being delivered. Thus special care must be taken especially when C38 ≠ 0 in that a voltage ≠ 0 may be created on terminals U,V,W without enabling the RUN command

2.2.7.3 Wait for Motor Demagnetizing

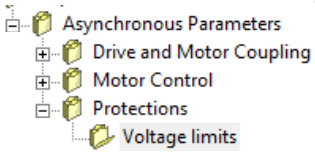
When the drive is switched off it is dangerous to switch on immediately, due to the unknown magnetic flux position that could produce a motor over–current. The only chance it's to wait the time needed for the magnetic flux to reduce itself with its time constant that depend on the motor type and can vary from few milliseconds to hundreds of milliseconds.

For this reason has been introduced the parameter **P28** that set the wait time after power switch off after that, it's possible to switch on the power another time: also if the user gives the RUN command during this wait time, the drive waits to complete it before enabling another time the power. Parameter P28 is defined in time units of 100us so the default value 10000 correspond to 1 second.

2.3 PROTECTION



2.3.1 Voltage Limits



Name	Description	Min	Max	Default	UM	Scale
AC_MAIN_SUPPLY	P87 - Main Supply voltage	180.0	780.0	400	V rms	10
DCBUS_MIN_MAIN_LOST	P97 - Minimum voltage level for forced mains off	100.0	1200.0	425	V	10
DCBUS_REF_MAIN_LOST	P98 - Voltage reference value in Support 1	220.0	1200.0	600	V	10
DCBUS_REG_KP	P86 - Kp3 Bus control proportional gain	0.05	10.00	3.5		100
KP_DCBUS	P105 - Corrective factor for Bus voltage	80.0	200.0	100	%	10
DCBUS_MIN	P106 - Minimum voltage of DC Bus	160.0	1200.0	400	V	10
DCBUS_MAX	P107 - Maximum voltage of DC Bus	350.0	1200.0	760	V	10
DCBUS_BRAKE_ON	P108 - Bus voltage threshold for brake ON	350.0	1200.0	730	V	10
DCBUS_BRAKE_OFF	P109 - Bus voltage threshold for brake OFF	350.0	1200.0	720	V	10
DCBUS_REF	P123 - Smart brake voltage cut-in level	300.0	1200.0	750	V	10
PW_SOFT_START_TIME	P154 - Soft start enabling time	150	19999	500	ms	1
MAIN_LOST_SEL	C34 - Managing mains failure	Range: 0 Trying to work; 1 Recovery; 2 Free; 3 Emergency brake		0		1
ALL_RST_ON_MAIN	C35 - Automatic alarm reset when mains back on	0	1	0		1
EN_DCBUS_MAX_CTRL	C47 - Enable smart brake	0	1	0		1
EN_PW_SOFT_START	C37 - Enable soft start	0	1	1		1
DC_BUS	D24 - Bus voltage			0	V	16
DC_BUS_RIPPLE	DC Bus Ripple at 100Hz			0	V	16
SOFT_STARTE_STATE	D34 - Power soft start state			8		1
STO_WAIT	P94 - Safe Torque Off Waiting time	0	2000	500	ms	1
DIS_MIN_VBUS	C89 - Disable minimum power circuit voltage with drive stopped	0	1	0		1
DCBUS_THR	P79 - DC Bus threshold for logic output o25	220.0	1200.0	800	V	10
EN_BRAKE_IN_STOP	C91 - Enable DC braking also in stop	0	1	0		1
DIS_DCBUS_RIPPLE_ALL	C31 - Disable DC Bus Ripple Alarm	0	1	0		1

If the Dc Bus exceeds its maximum value (P109) alarm A11 appears. If the DCBus is lower than its minimum value (P106) alarm A10 appears. In certain applications the DC Bus is charged only if all drivers are without alarms. In this case set C89=1, with the motor stopped, drive will be ready also without DCBus.

2.3.1.1 Power Soft Start (Pre-Charge Circuit)

The input stage of the OPDE drive is a rectifier bridge. This bridge may be a diode or semi-controlled (diode+SCR). The size from 03A to 60A have the diode bridge and the power soft start function acts bypassing (after some time set on the parameter P154) a soft start resistor in serieswith the output of the power bridge. In sizes from 70A to 460A the rectifier bridge is a semi-controlled type,a nd the power soft start function unblocks this input power bridge, permitting gradual charge of the DC Bus voltage capacitors.
NOTE: The connection C45 (BLU reserved parameter, whose setting is by the same) set the type of the rectifier bridge present in the drive:

0= diode bridge rectifier (3A÷60A);
1= semi-controlled bridge rectifier (70A÷460A).

After checked the correct setting of C45 connection, is very important to set C53 (reserved parameter, protected by key P60) for the choise of power supply type:

0= AC three-phase alternated voltage;
1= DC continuous voltage with internal power soft start ;
2= DC continuous voltage with external power soft start.

With **C53=0** choice **AC alternated voltage**, the power soft start function works, the same becomes active if the connection C37=1 and the presence of mains power supply is detected, with the following logic:
MAINS SUPPLY PRESENCE: if the presence of alternated mains supply voltage becomes noticed once (at power soft start function) with the logic power input MAINS_OFF=H, from that moment the control refers only to the MAINS_OFF to check the mains presence, otherwise is checked the DC Bus voltage with minimum threshould setup in P97.
MAINS BREAK OUT: is detected either monitoring the MAINS_OFF signal, if this went to the high logic level at least one time during the power soft start, either monitoring directly the DC Bus voltage with minimum threshould setup in P97.

With **C53=1** choice **DC continuous voltage with internal power soft start**, the power soft start function works, the same becomes active if the connection C37=1 and the presence of mains power supply is detected, with the following logic:
MAINS SUPPLY PRESENCE
AND MAINS BREAK OUT: logic input MAINS_OFF is ignored and it is possible to begin the power soft start, if the measured voltage on the DC Bus exceeds the indicated value in P97.
With this setting, automatically, P154 “PW_SOFT_START_TIME” goes at 10.000msec (10sec).
NOTE: In the size from 70A to 460A is not possible to set C53=1 (automatically switch to C53=2).

With **C53=2** choice **DC continuous voltage with external power soft start**, the OPDE drive is not concerned with power soft start of DC Bus circuit (in this case the power soft start must be external). As soon as the regulation card is powered (24V on connector X3), the drive closed the power soft start without any state control of the DC Bus.

Keep attention that this setting could damage internal drive capacitors.

The power fault alarm (power fault A03), that intervenes in case of OPDE drive over current, disables the insertion of power, just as happens with the Safe Torque Off (S.T.O.).
The power soft start follows the following criteria:

C53	MAINS SUPPLY PRESENCE		SOFT START ENABLE (o10)
	MAINS OFF	DC BUS	
0-AC	managed	managed on P97 threshold	on mains supply presence
1-DC internal PSS*	not	managed on P97 threshold	on mains supply presence
2-DC internal PSS*	not	managed on P97 threshold	instant power on of the regolation

(*) Power Soft Start

From default C37=1 thus connecting the drive to the mains supply, the power is enable immediately with the soft charging of the capacitors.
The soft start charge of the intermediate circuit capacitors lasts a preset time set in P154, after this time the voltage level is checked to verify the voltage level reached: if this is below the minimum (P97), the soft start alarm starts.

The drive is not enabled to switch on if soft start function has not ended successfully, if this happens the alarm A12.1 is activated.

To help the assistance, starting from 12.00 (asynchronous), software revisions is been introduced the internal value D34 that show the power soft start state:
0 – A3 =disabled a cause of alarm A3;
1 – STO ON= disabled a cause of safe torque off function;
2 – WAIT MAINS OFF= disabled, waiting MAINS_OFF signal;
3 – WAIT VBUS= disabled, waiting DC bus greater than P97;
4 – C37=0 =disabled, because C37=0;
5 – DIODES SOFT START= during DC bus capacitor charge with diode bridge;
6 – SCR SOFT START= during DC bus capacitor charge with semicontrolled power bridge;
7 – ALARM A13= disabled, after power soft start time(P154) Vbus didn't reach minimum value(P97);
8 – OK= enabled

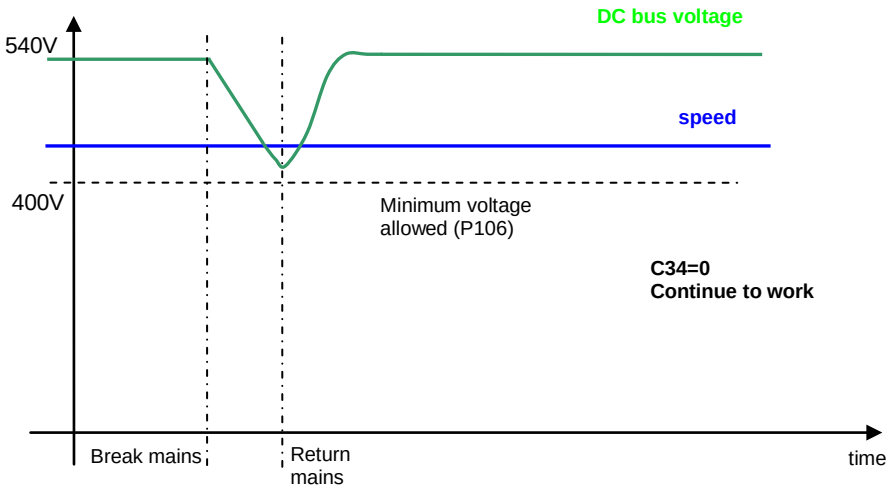
2.3.1.2 Voltage Break Control for Mains Feeding

The mains break control is configurable through the following connections:

Name	Description
MAIN_LOST_SEL	C34 - Managing mains failure
ALL_RST_ON_MAIN	C35 - Automatic alarm reset when mains back on

2.3.1.2.1 Continuing to Work (C34=0; Default)

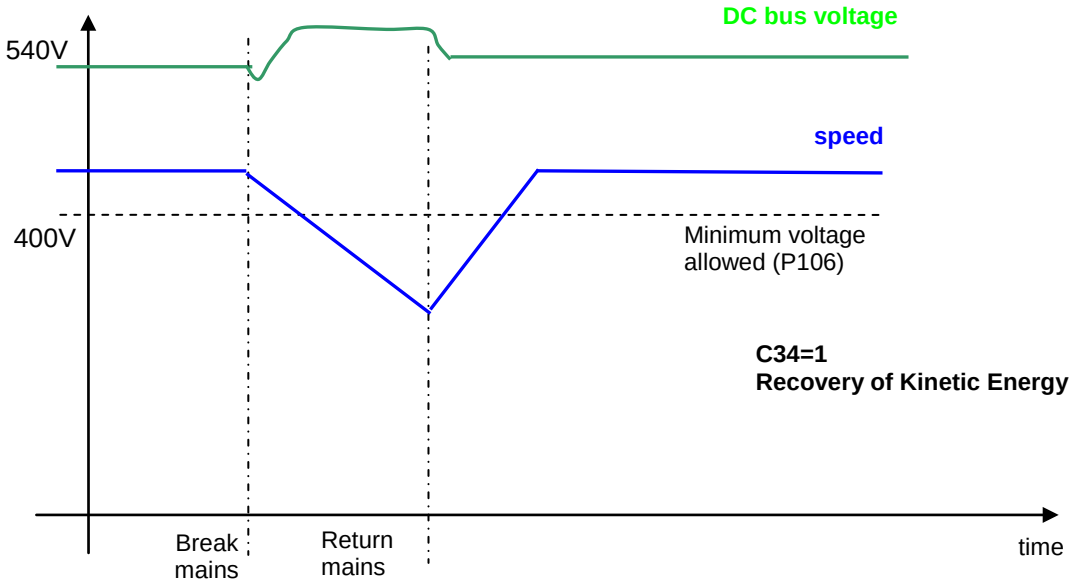
This operating procedure is adapted to those applications in which it is fundamental to have unchanged working conditions in each situation. Setting C34=0 the drive, even if the mains supply voltage is no longer available, continues to work as though nothing has been modified over the control, pulling the energy from the present capacitor to the inner drive. This way making the intermediate voltage of the DC Bus will begin to go down depending on the applied load; when it reaches the minimum tolerated value (in parameter P106) the drive goes into alarm A10 of minimum voltage and leaves to go to the motor in free evolution.
Therefore, this function will allow exceeding short-term mains break out (tenths/hundredths of milliseconds on the basis of the applied load) without changing the motor operation in any way.



If the alarm condition starts, there is the possibility to enable, setting C35=1 the alarms to an automatic reset at the mains restore.

2.3.1.2.2 Recovery of Kinetic Energy (C34=1)

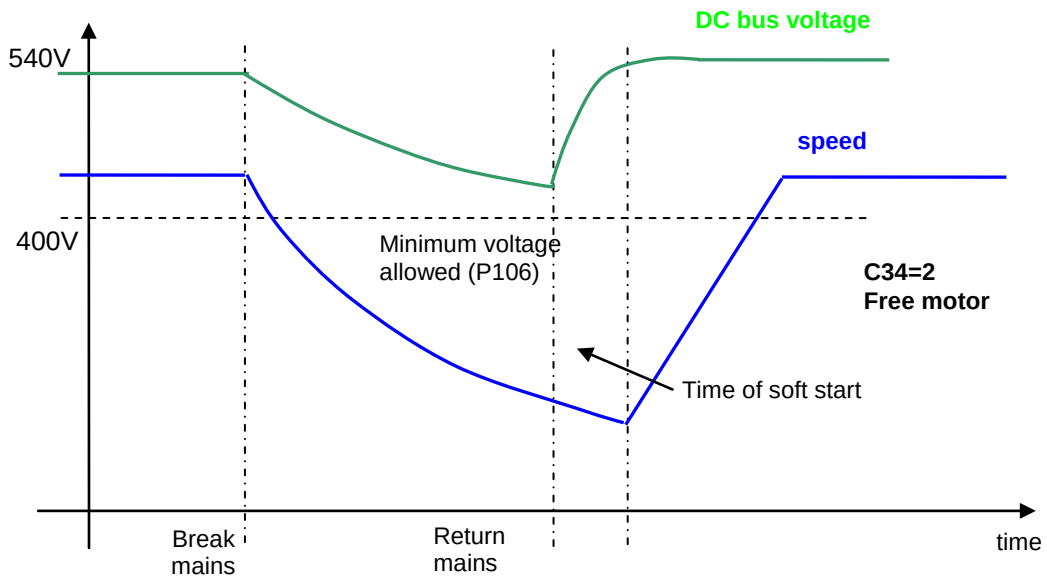
This operating procedure is adapted to those applications in which it is temporarily possible to reduce the speed of rotation to confront the mains break. This function particularly adapts in the case of fewer applied motors and with high energy.
The qualification of such a function is obtained setting C34=1.
During the mains break out, the voltage control of the DC Bus is achieved using a proportional regulator, with fixed proportional gain set in P86 (default=3.5), that controls the DC Bus voltage d24, compare it with the threshold in P98 (default=600V) and functions on the torque limits d30 of the motor that, in time, will slow down to work in recovery. Such regulation, when qualified (C34=1), at mains break out (o.L.12=H) or if the DC Bus voltage goes below the threshold set in P97 (425V), replaces the normal regulaion (o.L.13=H) and is excluded when mains supply is on.



If the alarm condition starts, there is the possibility to enable, setting C35=1 the alarms to an automatic reset at the mains restore

2.3.1.2.3 Overcoming Mains Breaks of a Few Seconds with Flyng Restart (C34=2)

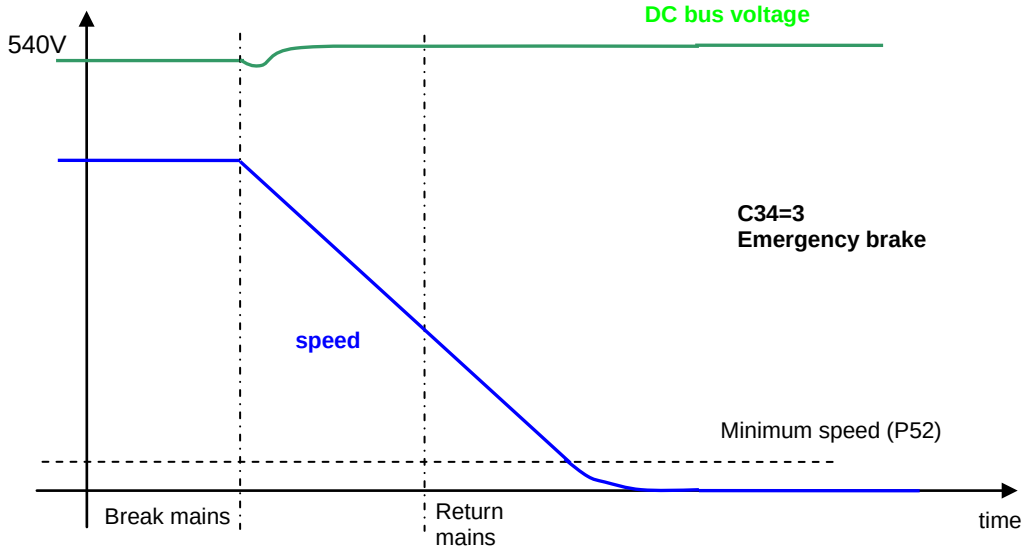
This operating procedure is adapted to those applications in which it is fundamental to not go into alarm in the case of mains break out and is temporarily prepared to disable the power in order for the motor to resume when the mains returns.
The qualification of such a function is obtained setting C34=2.
When there is a mains break or if the voltage of the Bus goes below the threshold set in P97r (425 V), the drive is immediately switched off, the motor rotates in free evolution and the Bus capacitors slowly discharges. If the mains returns in a few seconds, a fast recovery of the motor is carried out in a way in which the working regulation of the machine is resumed.



At the return of the mains, it will need to wait for the time of soft start for the gradual recharging of capacitors for the motor to be able to resume.

2.3.1.2.4 Emergency Brake (C34=3)

This particular control is adapted to those applications in which the machine may be stopped with an emergency brake in case of mains breaks.
Under this circumstance, the linear ramps becomes qualified and the ramp time is imposed with the parameter P30. When the minimum speed is reached, alarm A10 of minimum voltage starts and the motor is left rotating in free evolution. If in the meantime the mains returns, the emergency brake will be not interrupted.



2.3.1.2.5 Alarm (C34=4)

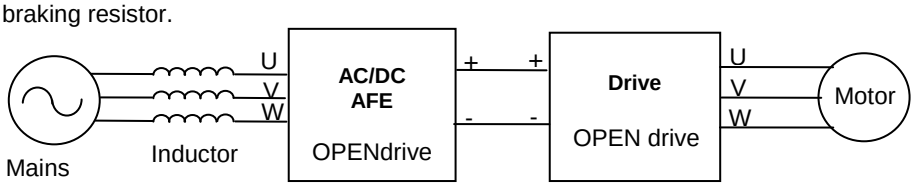
With this setting, immediately after a main supply loss, appears alarm A10.1.

2.3.1.3 Braking Management

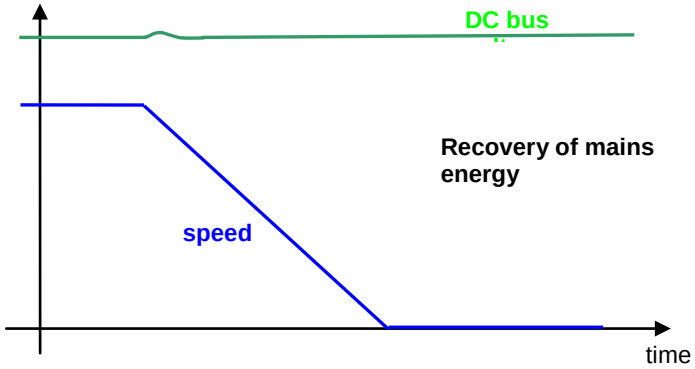
The drive is in a position to work on four quadrants, therefore is also in a position to manage the motor recovery Energy. There are three different, possible controls:

2.3.1.3.1 Recovery Mains Energy

To be able to restore the kinetic Energy into the mains, it is necessary to use another OPEN drive , specifically the **AC/DC Active Front End (AFE).** A Power Factor Controller deals with the position to have a power factor close to unity. Specific documentation is sent back from specific details. This solution is adapted to those applications in which the additional cost justifies another drive with a lot of energy that is recovered in the mains or for particular thermal dissipation problems in the use of a braking resistor.

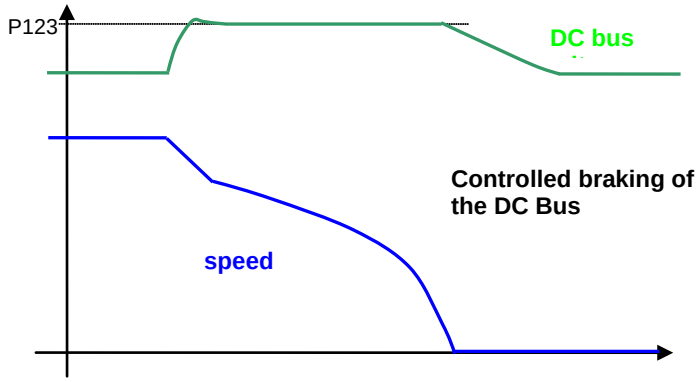


The use of an AC/DC AFE permits a controlled voltage level of the intermediate power (DC Bus) and raises to best control the motors winded to a voltage close to the line voltage. The drive's dynamic behavior results in a way that optimizes the work as motor or generator.
There is a possibility to connect more than one drive to the DC Bus, with the advantage of energy exchange between drives in case of contemporary movements and only one energy exchange with the mains.



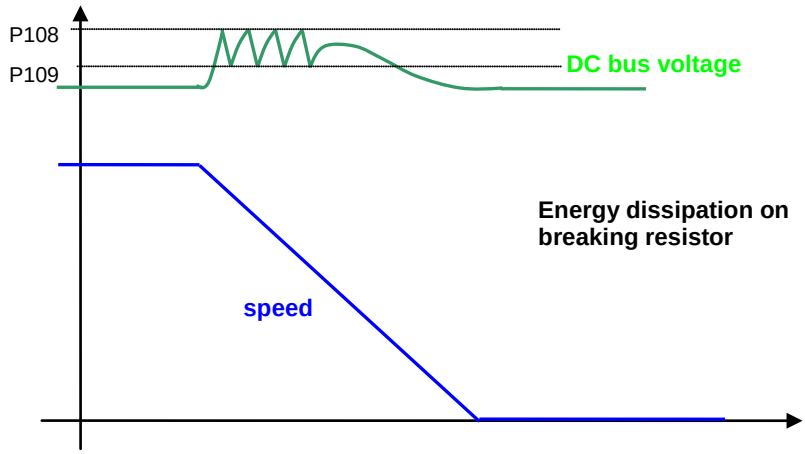
2.3.1.3.2 Braking with Dc Bus Control (C47=1)

A further possibility of recovery control of kinetic energy exists: if the outer braking resistance is not present (or is not working properly), it is possible to enable (setting **C47=1**) the braking with DC Bus control. This function, when the Bus voltage reaches the threshold set in **P123**, limits the maximum admitted regenerated torque, slowing down the motor. In practice, the motor will slow down in minimum time so the over voltage alarm does not start, exploiting the total losses of the motor and drive.
This function is not active by default (**C47=0**) in a way to leave the intervention of the braking circuit.



2.3.1.3.3 Kinetic Energy Dissipation on Breaking Resistance

The standard solution for the OPDE drive is the dissipation of kinetic Energy on braking resistor. All the OPEN drives could be equipped with an internal braking circuit, while the braking resistor must be connected externally, with the appropriate precautions.
With this solution, the Bus' maximum level of voltage becomes limited through a power device that connects in parallel the resistor with the DC Bus capacitors, if the voltage exceeds the threshold value in **P108**, the drive keeps it inserted until the voltage goes below the value of **P109**; in such a way, the energy that the motor transfers onto the DC Bus during the braking, is dissipated from the resistor.
This solution guarantees good dynamic behavior also in braking mode.
In the follow figure it's shown the Bus voltage and the speed during a dissipation on breaking resistance.



A maximum voltage limit allowed exists for the DC Bus voltage. This is checked by the software (threshold **P107**), and by the hardware circuitry: in case the voltage exceeds this level, the drive will immediately go into an over voltage alarm **A11** to protect the internal capacitors.
In case of A11 alarm condition starts, verify the correct dimensioning of the braking resistor power.

Refer to the installation manual for the correct dimensioning of the outer braking resistor.

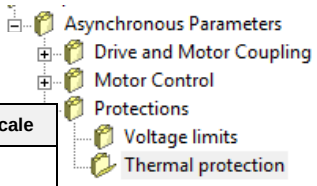
The braking resistor may reach high temperatures, therefore appropriately place the machine to favor the heat dissipation and prevent accidental contact from the operators.

With connection C91 it's possible to choose if the drive has to brake also in stop.
The default value is C91=0, to brake only in run state.

2.3.1.4 DC Bus Ripple Alarm

This function prevents the drive from rectifier bridge problems, unbalanced mains and main supply phase loss.
Using a 100Hz pass band filter, the DC Bus ripple is measured and shown in "DC_BUS_RIPPLE".
With a DC Bus ripple over 100V the drive goes in alarm A13.2 in 100ms.
With a DC Bus ripple from 60V to 100V the drive goes in alarm A13.2 in 5 seconds.
Connection C31 can be used to disable the DC Bus Ripple Alarm.

2.3.2 Thermal Protection



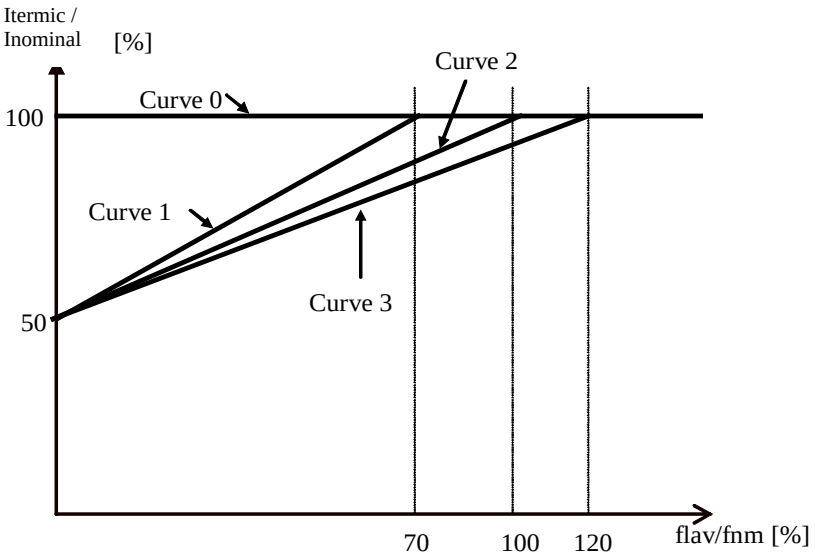
Name	Description	Min	Max	Default	UM	Scale
MOT_THERM_PRB_SEL	C46 - Enable motor thermal probe management (PTC/NTC)	Range 0 No 1 PTC 2 NTC 3 I23 4 KTY84-130		1		1
MOT_TEMP_MAX	P91 - Maximum motor temperature (if read with KTY84)	0.0	150.0	130	°C	10
DRV_THERM_PRB_SEL	C57 - Enable radiator heat probe management (PTC/NTC)	0	1	1		1
MOT_PRB_RES_THR	P95 - Motor NTC or PTC resistance value for alarm	0	50000	1500	Ohm	1
MOT_PRB_RES_THR_MUL	C70 - Motor NTC o PTC resistance multiplication factor	Range 0 X1 1 X10		0		1
PRC_MOT_DO_TEMP_THR	P96 - Motor thermal logic output 14 cut-in threshold	0.0	200.0	100	%	40.96
KP_MOT_THERM_PRB	P115 - Multiplication factor for motor PTC/NTC/KTY84 analog reference value	0.00	200.00	100		163.84
KP_DRV_THERM_PRB	P117 - Multiplication factor for radiator PTC/NTC analog reference value	0.00	200.00	100		163.84
DRV_TEMP_MAX	P118 - Max. temperature permitted by radiator PTC/NTC	0.0	150.0	90	°C	10
DRV_START_TEMP_MAX	P119 - Max. temperature permitted by radiator PTC/NTC for start-up	0.0	150.0	75	°C	10
DRV_DO_TEMP_THR	P120 - Radiator temperature threshold for logic output o.15	0.0	150.0	80	°C	10
EN_MOT_THERMAL_ALL	C32 - Motor thermal switch ' Block drive ?	0	1	1		1
MOT_THERM_CURV_SEL	C33 - Auto-ventilated thermal motors	Range 0 No reduction 1 -limitative 2 Self-ventilated 3 +limitative		0		1
KP_REG_THERM_PRB	P138 - Multiplication factor for regulation card thermal probe	0.00	200.00	100		163.84
DRV_TEMP	D25 - Radiator temperature reading			0	°C	16
MOT_TEMP	D26 - Motor temperature			0	°C	16
DRV_TEMP_TH_MODEL	Radiator temperature used by thermal model			0	°C	100
DRV_I_CONN_TH_MODEL	Drive inner connection limit			0	% DRV_I_CONN_MAX	100
REG_CARD_TEMP	D40 - Regulation card temperature			0	°C	16
MOT_PRB_RES	D41 - Thermal probe resistance			0	KOhm	16
PRC_DRV_I_THERM	D28 - Motor thermal current	-100	100	0	% soglia All	40.96
IGBT_J_TEMP	D45 - IGBT junction temperature			0	°C	16
IGBT_J_TEMP_MARGIN	D46 - IGBT junction temperature margin with its limit			0	°C	16
BRAKE_R	P140 - Braking resistance	1	1000	82	Ohm	1
BRAKE_R_MAX_EN	P142 - Braking resistance Maximum adiabatic Energy	0.0	500.0	4.5	KJoule	10
BRAKE_R_MAX_EN_TIME	P144 - Time measure of Braking resistance adiabatic Energy	0	30000	2000	ms	1
BRAKE_R_MAX_POWER	P146 - Maximum Power dissipated on Braking resistance	0.0	600.0	1.5	KWatt	100
BRAKE_R_TF	P148 - Power dissipated on Braking resistance filter time costant	1	2000	720	s	1
EN_BRAKE_R_PROT	C71 - Enable Braking resistance protection	Range 0 No 1 Classic 2 New		0		1
TEMP_ON_CONV_FANS	E93 - Switch-on temperature of converter fans	30	80	60	°C	1
BRAKE_R_AD_ENERGY	Adiabatic Energy dissipated on brake resistance				Joule	1
BRAKE_R_POWER	Average Power dissipated on brake resistance				Watt	1

2.3.2.1 Motor Thermal Protection

Parameters **P70** (thermal current as a % of the rated motor current), **P71** (motor thermal constant in seconds) and the current delivered by the drive are used to calculate the presumed operating temperature of the motor considering an ambient temperature equal to the permitted maximum; the losses are evaluated with the square of the absorbed current and filtered with the motor thermal constant. When this value exceeds the maximum thermal current set in P70 (value proportional to the square of this current) the thermal protection cuts in, enabling logic output **o.L.1** and alarm A06. The action taken may be programmed via connection **C32** and by enabling alarm **A06**:
If A06 is disabled, no action will be taken.
If A06 is enabled, action will depend on C32:

- C32 = 0 (default value) the thermal alarm will cut in and reduce the current limit to match the motor thermal current.
- C32 = 1 the thermal alarm cuts in and stops the drive immediately.

Internal value d28 and analog output 28 display a second-by-second reading of the motor thermal current as a percentage of the rated motor current. When 100% is reached, the motor thermal switch cuts in.
P96 can be set with an alarm threshold which, when breached, commutes logic output **o.L.14** to a high level indicating the approximation to the motor thermal limit.
The maximum motor thermal current depends on the operating frequency, provided that the motor does not have assisted ventilation regardless of its revolutions.
Four permitted thermal current curves are used to reduce the current in accordance with motor operating frequency (see diagram); the required curve is chosen with Connection C33 as per the table.



C33	Characteristics
0 [default]	No reduction according to frequency; to be chosen for assisted ventilation motors
1	Choose for self-ventilated high speed motors (2 poles) where ventilation is more efficient. There is no current reduction for frequencies over 70% of the rated frequency
2	Typical curve for self-ventilated motors
3	Curve for motors that heat up excessively with curve 2

The drive can manage the motor thermal probe. For the correct wiring of the probe, make reference to the installation manual.
The connection C46 selects the type of probe used:

C46	Description	Visualization D26
0	No motor thermal protection enabled	
1	**PTC management**: The thermal resistance is measured and compared to the maximum setup in the parameter **P95**, If the temperature exceeds the threshold, the **A5** alarm starts.	Thermal probe resistance in KΩ (D41)
2	**NTC management**: The thermal resistance is measured and compared to the minimum setup in the parameter **P95**, If the value is below, the **A5** alarm starts.	Thermal probe resistance in KΩ (D41)
3	**Termo-switch management: it's possible to configure a logic input to I23 function, in this case if this input goes to a low level the A5 alarm starts**	-----
4	KTY84: it's available the motor temperature (D26). If the motor temperature exceeds parameter P91 "MOTOR_TEMP_MAX", drive goes in A.5.0. The logical output function o14 goes at active level if the motor temperature is greater than threshold set with parameter P96 percent of P91.	Motor temperature (D26)

2.3.3 Braking Resistence Thermal Protection (OPDE)

The Braking Resistance Thermal protection protects the resistance both from Energy peaks and from average Power that have to be dissipated.
It's possible to enable this protection setting **C71**, by default this function is disabled.

2.3.3.1 Braking Resistance Instantaneous Power (C71=1)

The quickly Energy exchange is an adiabatic process since heat diffusion on case resistance is very slow, in the meantime the resistance is dimensioning for a maximum energy overload. This protection is based on the follow parameters:

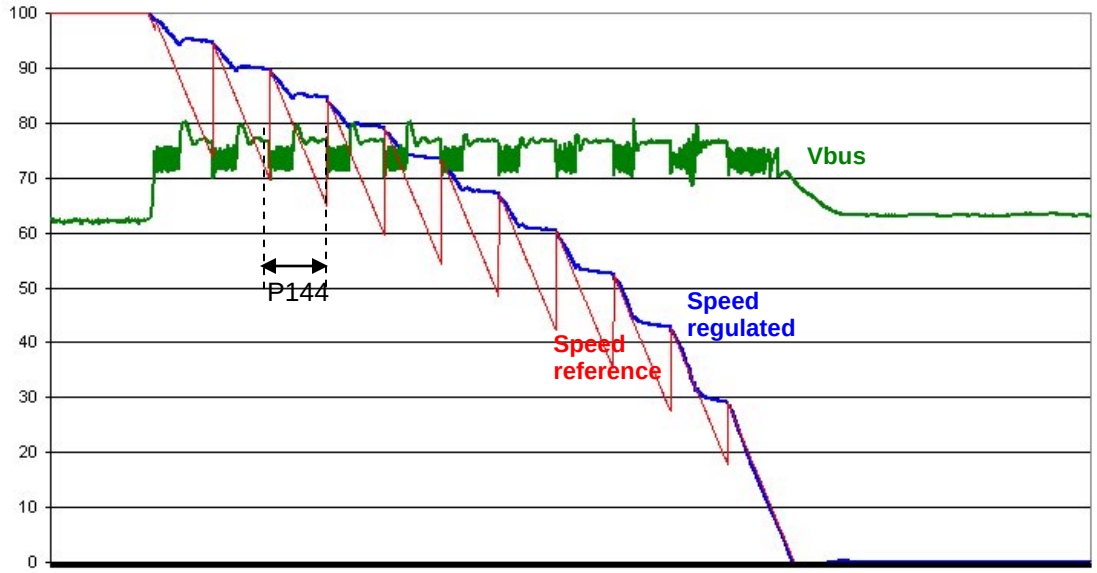
PAR	DESCRIPTION	RANGE	DEFAULT	UNIT	Internal rappr.
P140	Braking resistance value	1 ÷ 1000	82	Ohm	1
P142	Braking resistance Maximum Adiabatic Energy	0.0 ÷ 500.0	4.5	KJoule	10
P144	Time to test the Maximum Adiabatic Energy	1 ÷ 30000	2000	ms	1

After the first Braking resistance activation, the dissipated Energy is accumulated, knowing the DC bus voltage, the Braking resistance value and the activation time.
This accumulation is done for a time set in milliseconds in **P144** parameter: if in this period the Energy becomes greater than maximum threshold (set in KJoule into **P142** parameter) the control disables the Braking resistance. At that point, if it is enables the braking with DC Bus control (C34=1, see par 2.3.1.2.2) it starts to work, otherwise the alarm **A5.2** (Instantaneous Power Braking Resistance) becomes active.
At the end of every accumulation period it is possible to show the total dissipated Energy on the period in KJoule in the internal value "**BRAKE_R_AD_ENERGY"**, than can start a new period, the Braking resistance is enabled again and the speed reference is aligned with the real speed.

NB: this function has two possible uses:

- It takes the converter in alarm if the Instantaneous Power is too high (C34=0)
- It is possible to choose how many Energy could be dissipated on Braking resistance and in the remaining time braking with the DC Bus control (C34=1). With P144=1000ms it is possible to set in P142 the Power in KWatt that could be dissipated on the resistance.

In the follow figure is shown an experimental measurement of this function:



2.3.3.2 New Braking Resistance Instantaneous Power Protection (C71=2)

Starting from 12.10 revision is available also a new braking resistance instantaneous power protection, setting C71=2.
In this case P144 becames the fast time constant of resistance filament.
With this protection the resistance is more protected especially for repeated braking.
The alarm A5.2 occurs when is reached (80%) of max Adiabatic Energy.

2.3.3.3 Braking Resistance Average Power

The Energy dissipated every PWM period is used to estimate the average Power dissipated on Braking Resistance. The parameters used are:

PAR	DESCRIPTION	RANGE	DEFAULT	UNIT	Internal rappr.
P140	Braking resistance value	1 ÷ 1000	82	Ohm	1
P146	Braking Resistance Maximum Average Power	1 ÷ 30000	150	Watt	1
P148	Average Power Filter time constant	1 ÷ 2000	720	s	1

Every second the total dissipated Energy is equal to the Average dissipated Power.
This value is filtered with a first order filter with a time constant set in seconds in **P148** (the time constant depends on Braking Resistance thermal characteristics). In **P146** parameter is possible to set the maximum average power. In the internal value **"BRAKE_R_POWER"** it's possible to see the Average Dissipated Power in Watt, if this value becomes greater than the threshold P146 the alarm **A5.3** (Average Power Braking Resistance) becomes active.

2.3.4 Braking Resistance Thermal Protection (MiniOPDE)

In the MiniOPDE this protection, by default, is already enabled with the same connection, C71=2.
The parameters use to define the braking resistance characteristics are the same of OPDE.

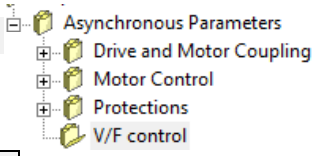
In the OPDExplorer "Default" section shows only the OPDE values, to see the real values of MiniOPDE select those concerned and do a reading (R).
The parameters shown are relative to the internal resistance of MiniOPDE.

The parameters used are reported in the following table:

PAR	DESCRIPTION	RANGE	DEFAULT (230V)	DEFAULT (400V)	UNIT	Internal rappr.
P140	Braking resistance	1 ÷ 1000	41	110	Ohm	1
P142	Braking resistance Maximum Adiabatic Energy	0.0 ÷ 500.0	0.5	0.5	KJoule	10

P144	Time measure of Braking resistance adiabatic Energy	1 ÷ 30000	1000	1000	ms	1
P146	Maximum Power dissipated on Braking resistance	0.0 ÷ 6000.0	0.03	0.03	KWatt	100
P148	Power dissipated on Braking resistance filter time constant	1 ÷ 2000	20	20	s	1

2.4 V/F CONTROL



Name	Description	Min	Max	Default	UM	Scale
EN_VF_CNTL	C80 - Enable V/f control	0	1	0		1
VF_EN_CHR_AUTOSET	C88 - Calculate V/f characteristic nominal knee	0	1	0		1
PRC_VF_SLIP_CMP	P170 - Slip motor compensation	0.0	400.0	0.0	% PRC_MOT_F_MAX	327.67
VF_TF_SLIP_CMP	P171 - Slip compensation factor filter	0.0	150.0	35.0	ms	10
PRC_VF_BOOST	P172 - Stator voltage drop compensation	0.0	400.0	70.0	% PRC_DELTA_VRS	40.96
VF_EN_DCJ	C83 - Enable dc brake	0	1	0		1
PRC_VF_DCJ_I_MAX	P173 - Current limit during continuous braking	0.0	100.0	100.0	% DRV_I_NOM	40.96
PRC_VF_DCJ_F_MAX	P174 - Continuous breaking maximum frequency limit	0.0	100.0	0.0	% PRC_MOT_F_MAX	40.96
PRC_VF_CHR_V1	P175 - V/f characteristic point 1 voltage	0.0	100.0	0.0	% PRC_MOT_V_MAX	40.96
PRC_VF_CHR_F1	P176 - V/f characteristic point 1 frequency	0.0	100.0	0.0	% PRC_MOT_F_MAX	40.96
PRC_VF_CHR_V2	P177 - V/f characteristic point 2 voltage	0.0	100.0	0.0	% PRC_MOT_V_MAX	40.96
PRC_VF_CHR_F2	P178 - V/f characteristic poitn 2 frequency	0.0	100.0	0.0	% PRC_MOT_F_MAX	40.96
PRC_VF_V_REG_D	P183 - Voltage regulator derivative coefficient multiplying term	0.0	100.0	100.0	%	327.67
VF_EN_SEARCH	C84 - Enable search during motor rotation	Range: 0 No; 1 Freq +; 2 Freq -; 3 Rif 0 +; 4 Rif 0 -		0		1
PRC_VF_FSTART_SEARCH	P184 - Initial search frequency with rotating motor	0.0	100.0	100.0	% PRC_MOT_F_MAX	40.96
PRC_VF_FMIN_SEARCH	P185 - Minimum search frequency with rotating motor	0.0	100.0	2.9	% PRC_MOT_F_MAX	40.96
PRC_VF_T_MAX_SEARCH	P191 - Torque limit during fly restart	0.0	100.0	5.0	% DRV_T_NOM	40.96
VF_EN_STALL_ALL	C82 - Enable stall alarm	0	1	1		1
VF_STALL_TIME	P186 - Working time during limit	1	100	30	s	1
PRC_VF_V_MAX_STATIC	P187 - Vs amplitude maximum static value	0.0	100.0	97.5	% PRC_MOT_V_MAX	327.67
VF_EN_ENGY	C86 - Enable energy saving	0	1	0		1
VF_TI_ENGY	P188 - Energy saving regulator lead time constant	100	2000	100	ms	1
PRC_VF_FLX_MIN_ENGY	P189 - Energy saving admissible minimum flux	0.0	100.0	20.0	% MOT_FLX_NOM	40.96
VF_EN_OPEN_LOOP	C85 - Enable open loop working state	Range: 0 No; 1 Imax in V/f; 2 Imax in V		0		1
VF_EN_BYPASS	C87 - Enable flux angle bypass - frequency input	0	1	0		1
VF_TF_I_MAX_AL	P190 - Current alarm filter	0.0	150.0	10.0	ms	10

2.4.1 Automatic Setting of Working Voltage/Frequency

"V/f control" manages the an asynchronous motor without feedback.
This type of control has a good dynamic performance also in flux weakening area (4-5 times base frequency) and it's able to start the motor also with high load (2 times the nominal motor torque), but it's no useful in that application where it's necessary to produce torque in steady state at frequency below 1Hz (in this case we recommend to use a motor with feedback and a Vector control).

To enable the voltage-frequency control set C80=characteristic

The most easier way to set the voltage-frequency characteristic is to use the automatic procedure.
First of all set the maximum motor voltage (P64) and the maximum working speed (P65) and then set C88=1 .

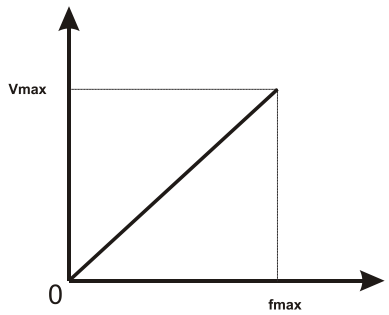
Name	Description
PRC_MOT_V_MAX	P64 - Max. operating voltage
MOT_SPD_MAX	P65 - Max. operating speed (n MAX)
VF_EN_CHR_AUTOSET	C88 - Calculate V/f characteristic nominal knee

Automatically the drive set the voltage-frequency characteristic in two possible way:

Linear way :

In this case, none characteristic points are set (P174-P175-P176-P177=0) and the maximum operating voltage P64 is set:

$$P64 = \frac{f_{max}}{f_{nom}}$$

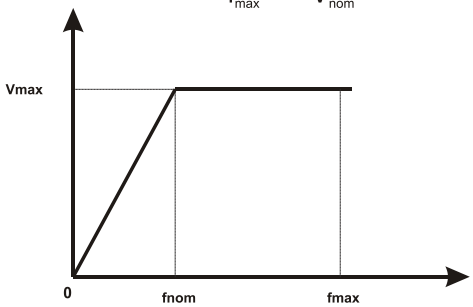


Characteristic FLUX WEAKENING AREA:

When the maximum motor frequency is greater than nominal frequency automatically is set one characteristic point into nominal knee:

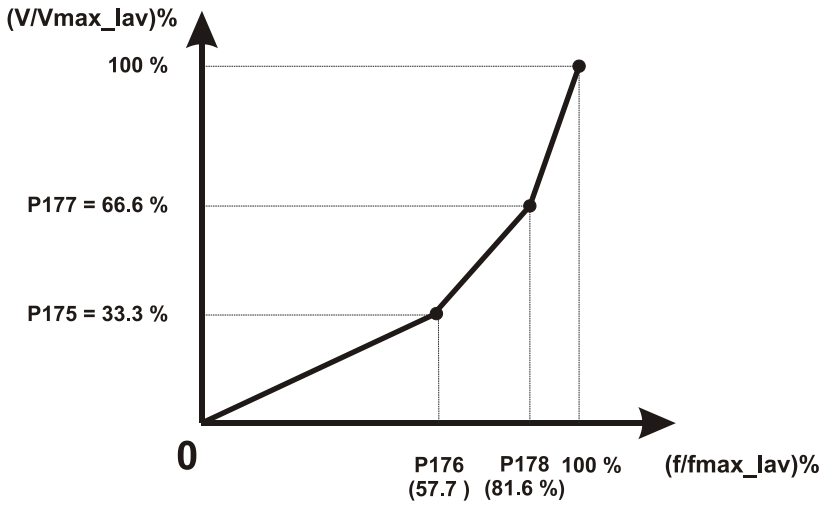
$$P175 = 100\%$$

$$P176 = \frac{f_{nom}}{f_{max}} \times \frac{V_{max}}{V_{nom}}$$



2.4.2 Manual Setting of Working Voltage/Frequency Characteristic

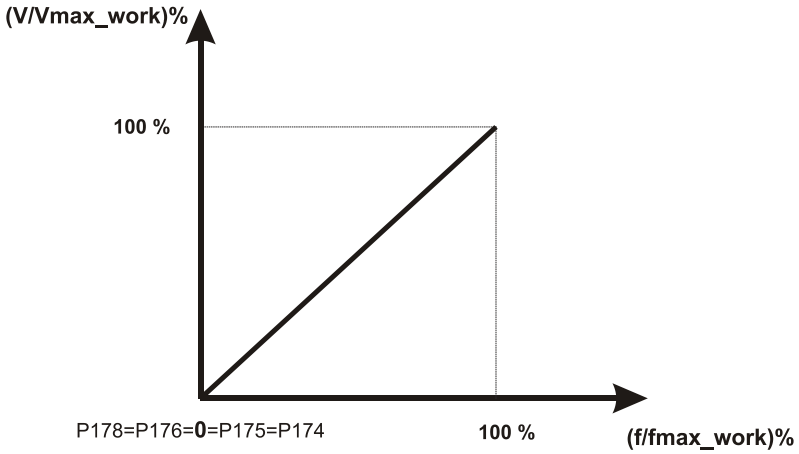
Using the parameters P175 , P176 , P177 and P178 it is possible to define a three-section working curve by points (so as to be better able to adjust to the desired characteristics).
Points P176 and P178 define the frequency percentage with reference to the maximum working frequency while points P175 and P177 define the percentage voltage with reference to the maximum working voltage (P64).
The following curve should clarify the explanation.



"TYPICAL CURVE WITH QUADRATIC TORQUE LOAD"

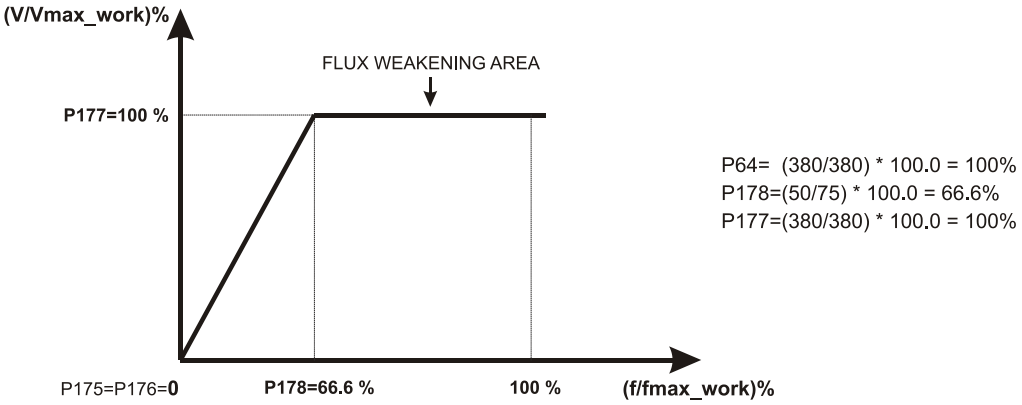
If a number of points which is less than two is sufficient to define the curve just program at 0 the frequencies of the points which are not used (P176 and/or P178), so that they will not be considered in the interpolation.
There are some limitations on setting the characteristic:
- Frequencies (P176 and P178) must be in rising order and the distance between two adjacent points must be greater than 5%
- Corresponding voltages (P175 and P177) must be in rising order.

If this limitations are not respected the system doesn't take in account the point whose component was set wrongly and it is cleared to 0. Every time one of this parameters (from P175 to P178) is changed, it is better to verify if the system has accepted the new value.
A linear type Voltage-Frequency characteristic is provided for the default for which P175=P176=P177=P178=0.



STANDARD CURVE FOR A MOTOR WORKING IN CONSTANT TORQUE IN ALL ITS CHARACTERISTICS

As an example we calculate the settings of the parameters in the case of a motor with a rated voltage of 380 Volts and a frequency of 50 Hz, which we want to work at full flux up to 50 Hz and a constant voltage from 50 Hz to 75 Hz.
Having traced the desired voltage-frequency we see that to program it is sufficient to use only one section point (see diagram).
From the maximum speed frequency desired (P65) and from the maximum working voltage (P64) we can calculate the P177 and P178 values with reference to the maximum values, while P175 and P176 will remain at 0.



CURVE FOR MOTOR WORKING ALSO IN FLUX WEAKENING AREA

2.4.3 Load Effect Compensation

2.4.3.1 Voltage Stator Drop Compensation (Start Up Under Load)

Using P36 parameter it is possible to increase the voltage value at low frequencies so as to compensate for the drop due to the stator resistance and so as to be able to have current and the refore torque even in the start up phase; this is necessary if the motors starts up under load. The value which can be set refers to the drop voltage on the Stator Resistor (P66) and can be adjusted from 0 up to a maximum of 400.0%. Particular care must be taken in setting the P172 value as it determines the current values fed at low speed: a value too low for P30 results in limiting the torque of the motor, while a value too high results in feeding high currents at low speed, whatever the load condition is.
In the start up under load it is useful to introduce a waiting time on the common 'converter running so that the motor can magnetize itself, so that it has from the outset the torque expected available. The **P29** parameter makes it possible to quantify this wait time in milliseconds, in which the system is in an on-line state, but the frequency reference is forcibly held at 0. The most suitable value for P29 should be chosen according to the rating of the motor and the load conditions, but in any case should be from a minimum of 400ms for motors of 7.5 KW up to 1s for motors of 55KW.

2.4.3.2 Slip Compensation

By using parameter **P170** it is possible to partly compensate for the motor's fall in speed when it takes up the load; the adjustment is in fact that regulation of motor controls stator frequency and does not control the real speed.
This compensation is obtained by increasing the motor's working frequency by a quantity which is proportional to the percentage working torque multiplied by the percentage value set in P170 , in relation to the motor's rated frequency.
The value to be set depends both on the motor's rating and poles, in any case it can in general terms vary from 4% for a 7.5 KW motor to 1,8 - 2.0% for 45 KW motors. In default the compensation is excluded P170 = 0.

2.4.4 Particular Control Functions

2.4.4.1 Motor Flying Restart

Since the driver has a maximum current limit it can always be started running with no problems even if the motor is already moving, for example, by inertia or dragged by part of the load. In that event, on starting up, given that normally the frequency reference starts from values close to zero to gradually rise with the ramp times to the working value, the motor is first subjected to a sudden deceleration, within the limit, to then hook onto the reference and follow it with the ramp; this may be undesirable from a mechanical standpoint, and the process could also trigger the overvoltage alarm for converters which do not have a braking device. To avoid this it is possible to suitably program connection **C84** , "Enable motor flying restart", which makes it possible to identify the speed of rotation of the motor, stressing it as little as possible, and to position the output reference from the ramp at a value corresponding to that rotation so as to start from that reference to then go on to working values. This motor search function is primarily in one direction and thus needs to know in advance the direction of rotation of the motor, positive frequency or negative frequency, which must be programmed in C84 ; if the selection is wrong the motor is first braked to about zero speed to then follow the reference to go to working speed (as if the search function had not been used). If there is a passive load and the inertia keeps the motor in rotation, it's possible to select a search dependently upon the sign of enabled frequency reference (C84=3-4).
There are two different values for C84 to enable this kind of search, the only difference is for manage the case in which the frequency reference was zero: in this particular situation with C84=3 the system searches for positive frequency, while with C84=4 the search will be made for negative frequency.
The C50 connection has five programming values which are selected as indicated below :

- o C84=0 flying restart doesn't enabled
- o C84=1 flying restart managed with positive frequency quadrant search
- o C84=2 flying restart managed with negative frequency quadrant search
- o C84=3 flying restart managed dependently upon the sign of enabled frequency reference (like C84=1 for 0)
- o C84=4 flying restart managed dependently upon the sign of enabled frequency reference (like C84=2 for 0)

The start frequency in motor flying restart can be set in parameter **P184** (default 100%) in percentage of maximum frequency. This parameter can help the search algorithm limiting the range of frequency. With parameter **P185** it's possible to set the minimum target frequency in order to inject an active current also if the motor is stopped.
If the maximum frequency is greater than 250% of nominal motor frequency could be some problems in the motor flying restart because it's difficult to inject the active current with a slip so high. In that case the only possibility is to reduce the start search frequency (with P184) on condition that really the motor cannot run more quickly.

If it's enabled the motor flying restart, the power is switch-on with the motor standstill and there is low load, it's possible to have a transient initial state in which the motor starts running in the searching sense.

If the flying restart doesn't work correctly it's possible to increase the reserved parameter **P191** (default value 5%) for increase the admitted search window .
In default the flying restart isn't managed (C84=0)

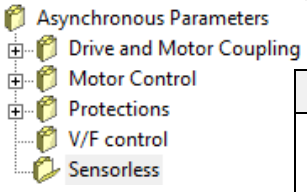
2.4.4.2 Dc Injection

The DC Injection, if enabled with **"VF_EN_DCJ"** C83=1, keeps the motor "stopped in torque" by injecting a continuous current if the frequency reference is under the intervention threshold express in "**PRC_VF_DCJ_F_MAX"** P174. With this function is possible to obtain only a low torque (< 10% of nominal value) at zero speed for the asynchronous motor characteristics, if the active load torque is greater than this value the motor runs at slip frequency correspondent to the load applied.
When the DC Injection is active the amplitude of the current depends on parameter "**PRC_VF_DCJ_I_MAX"** P173 which is the current limit in this situation.
Remember that if is active the "**VF_EN_STALL_ALL**" (C82=1) after the time express in "**VF_STALL_TIME**" P186, the converter will be in alarm (A.0.1).

2.4.4.3 Energy Saving

This function, if enabled with **"EN_ENERGY_SAVE"** C86=1, allows an energy saving with an automatic current reduction matched to the load, reducing the conduction loss (proportional to the current square value). The basic idea is to find the best subdivision between active and reactive current, because the first is proportional to the torque current, the second to the magnetic field produced. With reduced working load it's better to reduce the magnetic field under its nominal value and increase the torque current.
The energy saving is significant especially for motors with low cos φ and for load lower than 40-50% of nominal value, for load much great of this the saving is negligible.
When the Energy Saving is enabled the dynamic performances decreases also if it's always guarantee a good stability in every working area.

2.5 SENSORLESS



Name	Description	Min	Max	Default	UM	Scale
EN_ON_LINE_CMP	C65 - Enable sensorless on line parameters compensation	Range 0 No 1 VRs_start 2 VRs_online 3 VRs_always		1		1
SLESS_KRs	Sensorless on line Stator Resistance compensation term			100	%	40.96
SLESS_KLs	Sensorless on line Leakage Inductance compensation term			100	%	40.96
SLESS_FLUX_ERR	Sensorless voltage and current flux error			0.0	% MOT_FLX_NOM	4096
PRC_IQ_COMP_THR	P192 - Minimum active current for sensorless flux compensation	0.0	400.0	50.0	% DRV_T_NOM	40.96
PRC_FLUX_COMP_THR	P193 - Maximum flux for sensorless flux compesation	0.0	400.0	90.0	% MOT_FLUX_NOM	40.96
PRC_VS_COMP_THR	P194 – Minimum voltage for sensorless flux compesation	0.0	400.0	50.0	% MOT_V_NOM	40.96
SLESS_Kp	Sless observer proportional gain			0		100
SLESS_Ta	Sless observer laed time			0	ms	10
SLESS_Tf	Sless observer time filter			0	ms	10

Sensorless control is enabled choosing **C00=0-sensorless**.
When sensorless control is enabled automatically some parameters are changed:
P126=40%, P127=40%, P157=3µs, P56=10%.

Commissioning suggested:

- Execute only the first part of autotuning measure (C42=1);
- Measure the start-up time (EN_TEST_SPD= 1- Start-up);
- Set speed regulator with lower bandwidth (0.5÷1Hz);
- Disable autotuning starting from default values C75=1;
- Execute the second part of autotuning measure (C42=2);
- Increase speed regulator bandwidth up to max "SPD_LOOP_BW_MAX".

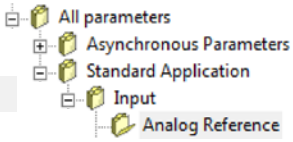
With sensorless control there is a lower limit on works electric frequency of 0.5 Hz.
At present isn't possible starts with motor in rotation.

It's preferable to enable a on-line compensation on stator resistance and leakage inductance.
Leakage compensation works only if the active current request is greater than P192 if working frequency referred to nominal frequency is greater than P76, if the flux is lower than P193 and the stator voltage is greater than P194.
With the default setting the leakage compensation works only in the flux weakening area, to avoid wrong compensation due to saturation problem.
Resistance compensation can be enabled with connection C65:

C65	Description
0 - No	never
1 - VRs_start	During motor magnetization, stator resistance is measured. NB: this function works well only if the motor is stopped at start.
2 - Vrs_online	Resistance compensation works only if the torque request is greater than 30% and if working frequency referred to nominal frequency is lower than P76.
3 – VRs_always	1 + 2 , compensation during magnetization and on-line

3 STANDARD APPLICATION

3.1 INPUTS



3.1.1 Analog Reference

Name	Description	Min	Max	Default	UM	Scale
EN_AI1_4_20mA	C95 - Enable AI1 4-20mA	0	1	0		1
KP_AI1	P01 - Corrective factor for analog reference 1 (AUX1)	-400.0	400.0	100	%	10
OFFSET_AI1	P02 - Corrective offset for analog reference 1 (AUX1)	-100.0	100.0	0	%	163.84
AI1	D42 - Analog Input AI1	-100	100	0	%	163.84
EN_AI1	E00 - Enable analog reference value A.I.1	0	1	0		1
REF_AI1	D64 - Reference from Analog Input AI1	-100	100	0	%	163.84
AI1_SEL	E03 - Meaning of analog input A.I.1	Range 0 Speed ref. 1 Torque ref. 2 Symmetrical Torque limit ref 3 Positive Torque limit ref 4 Negative torque limit ref 5 Symmetrical Speed limit ref 6 Positive Speed limit ref 7 Negative Speed limit ref		0	1	
EN_AI2_4_20mA	C96 - Enable AI2 4-20mA	0	1	0		1
KP_AI2	P03 - Corrective factor for analog reference 2 (AUX2)	-400.0	400.0	100	%	10
OFFSET_AI2	P04 - Corrective offset for analog reference 2 (AUX2)	-100.0	100.0	0	%	163.84
AI2	D43 - Analog Input AI2	-100	100	0	%	163.84
EN_AI2	E01 - Enable analog reference value A.I.2	0	1	0		1
REF_AI2	D65 - Reference from Analog Input AI2	-100	100	0	%	163.84
AI2_SEL	E04 - Meaning of analog input A.I.2	Range 0 Speed ref. 1 Torque ref. 2 Symmetrical Torque limit ref 3 Positive Torque limit ref 4 Negative torque limit ref 5 Symmetrical Speed limit ref 6 Positive Speed limit ref 7 Negative Speed limit ref		1		1
EN_AI3_4_20mA	C97 - Enable AI3 4-20mA	0	1	0		1
KP_AI3	P05 - Corrective factor for analog reference 3 (AUX3)	-400.0	400.0	100	%	10
OFFSET_AI3	P06 - Corrective offset for analog reference 3 (AUX3)	-100.0	100.0	0	%	163.84
AI3	D44 - Analog Input AI3	-100	100	0	%	163.84
EN_AI3	E02 - Enable analog reference value A.I.3	0	1	0		1
REF_AI3	D66 - Reference from Analog Input AI3	-100	100	0	%	163.84

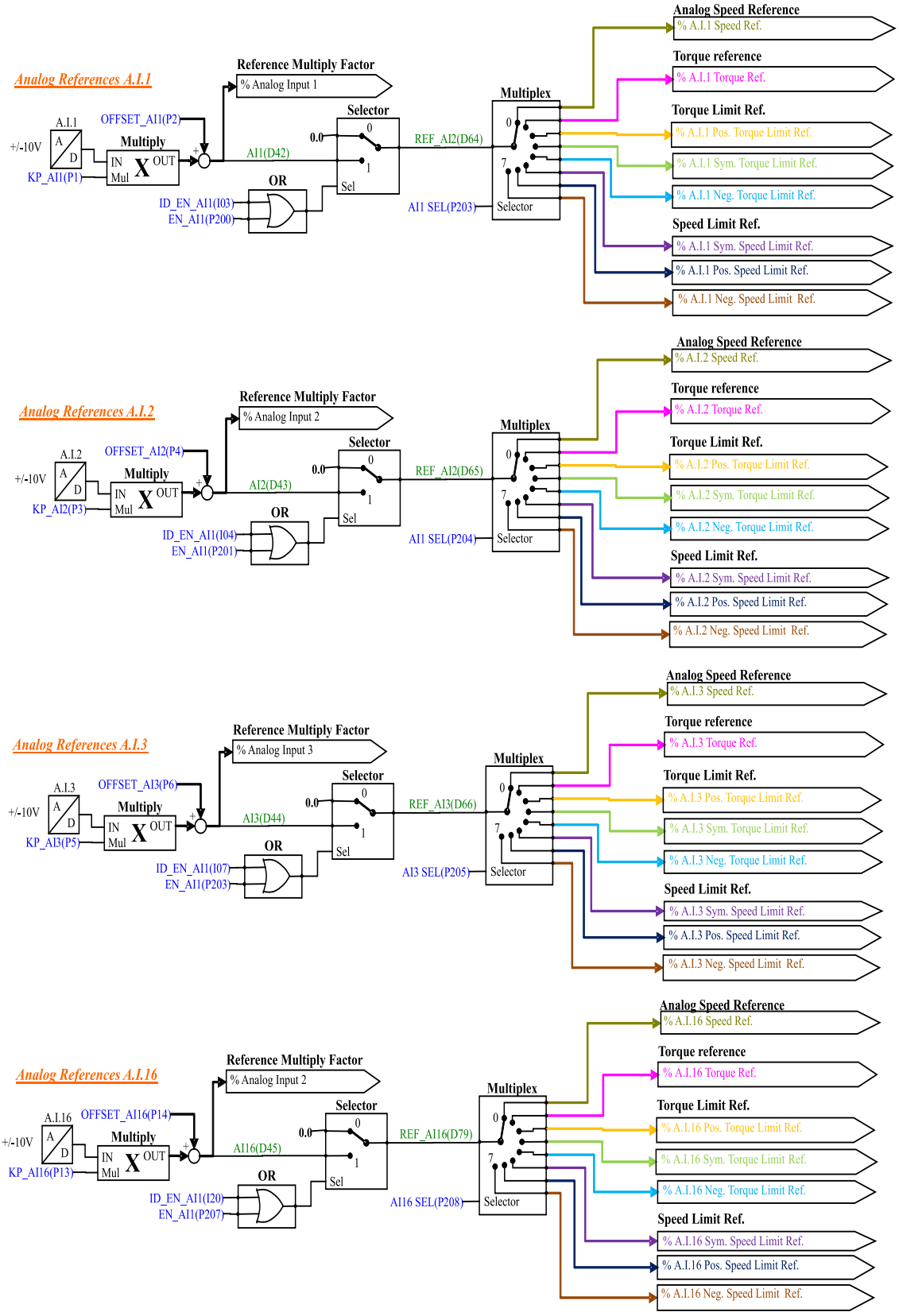
Name	Description	Min	Max	Default	UM	Scale
AI3_SEL	E05 - Meaning of analog input A.I.3	Range		2		1
		0	Speed ref.			
		1	Torque ref.			
		2	Symmetrical Torque limit ref			
		3	Positive Torque limit ref			
		4	Negative torque limit ref			
		5	Symmetrical Speed limit ref			
		6	Positive Speed limit ref			
		7	Negative Speed limit ref			
KP_AI16	P13 - Corrective factor for 16 bit analog reference (AUX16)	-400.0	400.0	100.0	%	10
OFFSET_AI16	P14 - Corrective offset for 16 bit analog reference (AUX16)	-100.0	100.0	0	%	163.84
AI16	16 bit analog input (optional)	-100.00	100.00	0.00	%	163.84
EN_AI16	E07 - Enable analog reference value AI16	0	1	0		1
REF_AI16	D79 - Reference from Analog Input AI16				%	163.84
AI16_SEL	E08 - Meaning of analog input AI16	Range		0		1
		0	Speed ref.			
		1	Torque ref.			
		2	Symmetrical Torque limit ref			
		3	Positive Torque limit ref			
		4	Negative torque limit ref			
		5	Symmetrical Speed limit ref			
		6	Positive Speed limit ref			
		7	Negative Speed limit ref			
TF_TRQ_REF_AN	E06 - Filter time constant for analog torque reference value	0.0	20.0	0	ms	10
PRC_T_REF_AN	D68 - Analog Torque reference from Application	-400	400	0	% MOT_T_NOM	40.96
PRC_APP_T_REF	D10 - Torque reference value (application generated)	-100	100	0	% MOT_T_NOM	40.96
PRC_T_MAX_AN_POS	D70 - Analog Positive Torque Max from Application	-400	400	0	% MOT_T_NOM	40.96
PRC_T_MAX_AN_NEG	D80 - Analog Negative Torque Max from Application	-400	400	0	% MOT_T_NOM	40.96
PRC_SPD_MAX_AN_POS	D82 - Analog Positive Speed Max from Application	-200	200	0	% MOT_SPD_NOM	40.96
PRC_SPD_MAX_AN_NEG	D83 - Analog Negative Speed Max from Application	-200	200	0	% MOT_SPD_NOM	40.96
MUL_AI_IN_SEL	E41 - Multiplication factor selection	0	4	0		1
MUL_AI_OUT_SEL	E42 - Multiplication factor target	0	2	0		1
MUL_AI_MAX	E43 - Max analog input value for multiplication factor	-180.00	180.00	100.0	% A.I.	163.84
MUL_AI_MIN	E44 - Min analog input value for multiplication factor	-180.00	180.00	0.0	% A.I.	163.84
MUL_KCF_MAX	E45 - Multiplication factor with max analog input (MUL_AI_MAX)	-100.0	100.0	1.0		100
MUL_KCF_MIN	E46 - Multiplication factor with min analog input (MUL_AI_MAX)	-100.0	100.0	-1.0		100
PRC_SPD_TOT_AN	D72 - Speed reference from AI1 + AI2 + AI3 + AI16	-100	100	0	% MOT_SPD_MAX	163.84
STR_MUL_AI	E48 - Storing input multilpicative factor	0	2	0		1
MUL_KP	D73 - Multiplication factor	-100.0	100.0	0		16
PRC_SPD_REF_AN	D74 - Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_APP_SPD_REF	D33 - Speed reference (application generated)	-100	100	0	% MOT_SPD_MAX	163.84
PRC_SPD_TOT_AN_DZ	E09 - Analog speed/PID error - Dead zone amplitude	0.00	100.00	0	% MOT_SPD_MAX	163.84

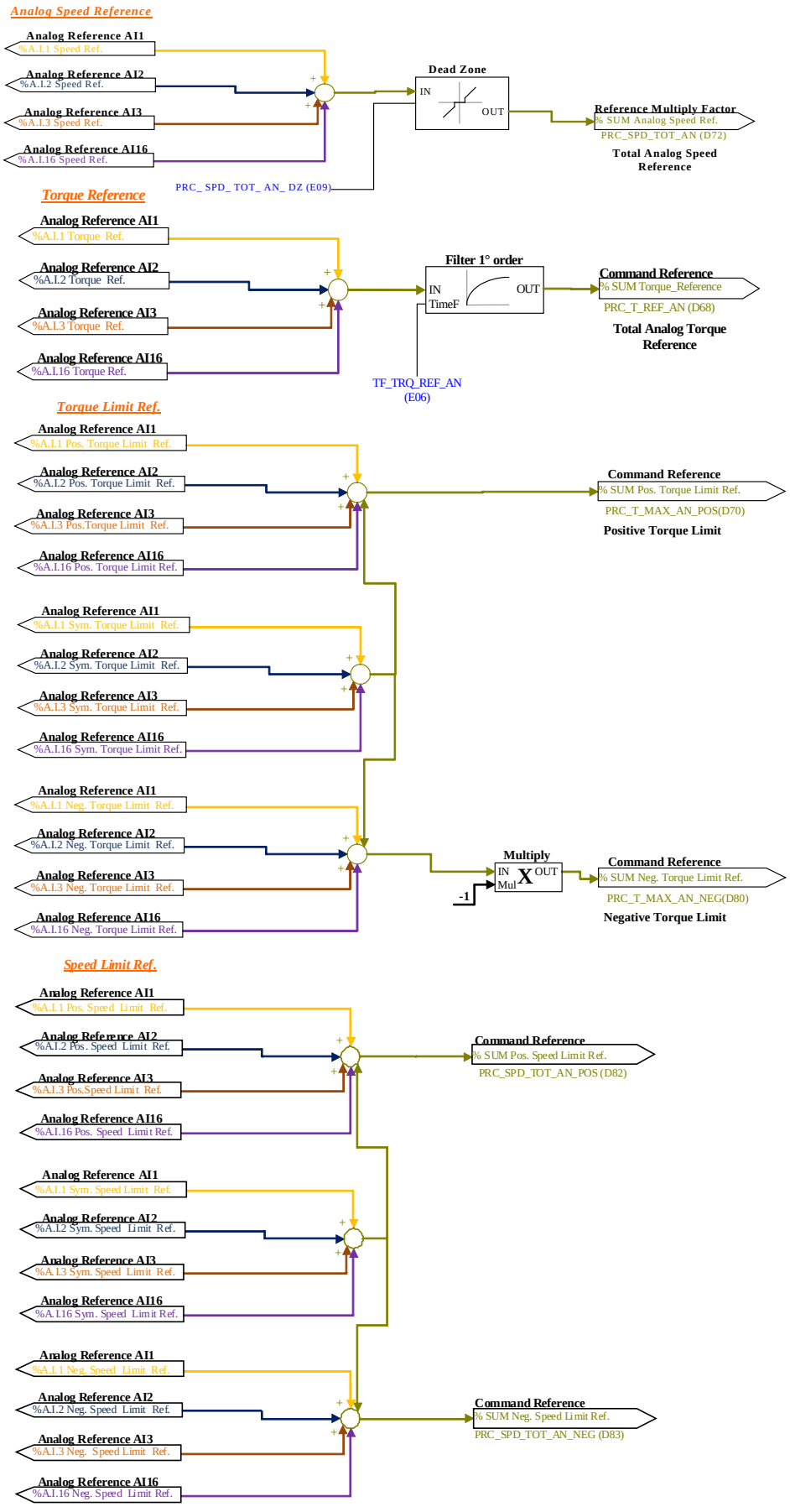
3.1.2 Current Analog Reference 4÷20ma

If the user wants to give references in current (4÷20 mA signals), it's necessary to set correctly the dip-switch sw1 in the display card (see installation manual 5.2.17). After that, for every analog input it's possible to enable, with connections C95÷C97, the correct software manage of these inputs. When the 4÷20 mA function is enabled, automatically is set KP_Ax=125% and OFFSET_Aix=-25%, in this way with 4 mA the reference is 0 and with 20 mA the reference is 100%. Furthermore there is a software lower limitation to 0%, so with current reference lower than 4 mA, the real reference is 0.
It's possible to enable separately all references using connections or logic input functions.
For speed and torque references the active reference is the sum of all enabled references, for torque and speed limit prevails the more constrain active reference, between the sum of analog and the Fieldbus references

There can be up to 4 differential analog inputs (A.I.1 ÷ A.I.16) ± 10V which, after being digitally converted with a resolution of 14 bits, can be:

- conditioned by digital offset and a multiplicative coefficient
- enabled independently through configurable logic inputs or connections
- configured as meaning through the corresponding connection (**E03** ÷ **E05**)
- added together for the references with the same configuration

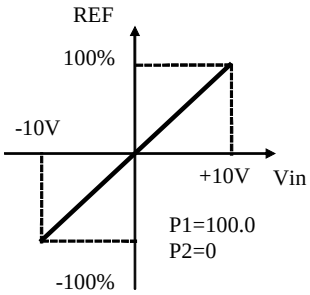

Analog References A.I.1
A.I.1
+/-10V
A
D
OFFSET_AI1(P2)
Multiply
IN
Mul
X
OUT
KP_AI1(P1)
Reference Multiply Factor
% Analog Input 1
AI1(D42)
Selector
0.0
0
1
Sel
OR
ID_EN_AI1(I03)
EN_AI1(P200)
REF_AI2(D64)
Multiplex
0
7
AI1 SEL(P203)
Selector
Analog Speed Reference
% A.I.1 Speed Ref.
Torque reference
% A.I.1 Torque Ref.
Torque Limit Ref.
% A.I.1 Pos. Torque Limit Ref.
% A.I.1 Sym. Torque Limit Ref.
% A.I.1 Neg. Torque Limit Ref.
Speed Limit Ref.
% A.I.1 Sym. Speed Limit Ref.
% A.I.1 Pos. Speed Limit Ref.
% A.I.1 Neg. Speed Limit Ref.
Analog References A.I.2
A.I.2
OFFSET_AI2(P4)
KP_AI2(P3)
% Analog Input 2
AI2(D43)
ID_EN_AI1(I04)
EN_AI1(P201)
REF_AI2(D65)
AI1 SEL(P204)
% A.I.2 Speed Ref.
% A.I.2 Torque Ref.
% A.I.2 Pos. Torque Limit Ref.
% A.I.2 Sym. Torque Limit Ref.
% A.I.2 Neg. Torque Limit Ref.
% A.I.2 Sym. Speed Limit Ref.
% A.I.2 Pos. Speed Limit Ref.
% A.I.2 Neg. Speed Limit Ref.
Analog References A.I.3
A.I.3
OFFSET_AI3(P6)
KP_AI3(P5)
% Analog Input 3
AI3(D44)
ID_EN_AI1(I07)
EN_AI1(P203)
REF_AI3(D66)
AI3 SEL(P205)
% A.I.3 Speed Ref.
% A.I.3 Torque Ref.
% A.I.3 Pos. Torque Limit Ref.
% A.I.3 Sym. Torque Limit Ref.
% A.I.3 Neg. Torque Limit Ref.
% A.I.3 Sym. Speed Limit Ref.
% A.I.3 Pos. Speed Limit Ref.
% A.I.3 Neg. Speed Limit Ref.
Analog References A.I.16
A.I.16
OFFSET_AI16(P14)
KP_AI16(P13)
% Analog Input 2
AI16(D45)
ID_EN_AI1(I20)
EN_AI1(P207)
REF_AI16(D79)
AI16 SEL(P208)
% A.I.16 Speed Ref.
% A.I.16 Torque Ref.
% A.I.16 Pos. Torque Limit Ref.
% A.I.16 Sym. Torque Limit Ref.
% A.I.16 Neg. Torque Limit Ref.
% A.I.16 Sym. Speed Limit Ref.
% A.I.16 Pos. Speed Limit Ref.
% A.I.16 Neg. Speed Limit Ref.


Analog Speed Reference
Analog Reference AI1
%A.I.1 Speed Ref.
Analog Reference AI2
%A.I.2 Speed Ref.
Analog Reference AI3
%A.I.3 Speed Ref.
Analog Reference AI16
%A.I.16 Speed Ref.
Dead Zone
IN
OUT
Reference Multiply Factor
% SUM Analog Speed Ref.
PRC_SPD_TOT_AN (D72)
Total Analog Speed Reference
PRC_ SPD_ TOT_ AN_ DZ (E09)
Torque Reference
Analog Reference AI1
%A.I.1 Torque Ref.
Analog Reference AI2
%A.I.2 Torque Ref.
Analog Reference AI3
%A.I.3 Torque Ref.
Analog Reference AI16
%A.I.16 Torque Ref.
Filter 1° order
IN
TimeF
OUT
Command Reference
% SUM Torque_Reference
PRC_T_REF_AN (D68)
Total Analog Torque Reference
TF_TRQ_REF_AN (E06)
Torque Limit Ref.
Analog Reference AI1
%A.I.1 Pos. Torque Limit Ref.
Analog Reference AI2
%A.I.2 Pos. Torque Limit Ref.
Analog Reference AI3
%A.I.3 Pos.Torque Limit Ref.
Analog Reference AI16
%A.I.16 Pos. Torque Limit Ref.
Command Reference
% SUM Pos. Torque Limit Ref.
PRC_T_MAX_AN_POS(D70)
Positive Torque Limit
Analog Reference AI1
%A.I.1 Sym. Torque Limit Ref.
Analog Reference AI2
%A.I.2 Sym. Torque Limit Ref.
Analog Reference AI3
%A.I.3 Sym. Torque Limit Ref.
Analog Reference AI16
%A.I.16 Sym. Torque Limit Ref.
Analog Reference AI1
%A.I.1 Neg. Torque Limit Ref.
Analog Reference AI2
%A.I.2 Neg. Torque Limit Ref.
Analog Reference AI3
%A.I.3 Neg. Torque Limit Ref.
Analog Reference AI16
%A.I.16 Neg. Torque Limit Ref.
Multiply
IN
Mul
X
OUT
-1
Command Reference
% SUM Neg. Torque Limit Ref.
PRC_T_MAX_AN_NEG(D80)
Negative Torque Limit
Speed Limit Ref.
Analog Reference AI1
%A.I.1 Pos. Speed Limit Ref.
Analog Reference AI2
%A.I.2 Pos. Speed Limit Ref.
Analog Reference AI3
%A.I.3 Pos.Speed Limit Ref.
Analog Reference AI16
%A.I.16 Pos. Speed Limit Ref.
Command Reference
% SUM Pos. Speed Limit Ref.
PRC_SPD_TOT_AN_POS (D82)
Analog Reference AI1
%A.I.1 Sym. Speed Limit Ref.
Analog Reference AI2
%A.I.2 Sym. Speed Limit Ref.
Analog Reference AI3
%A.I.3 Sym. Speed Limit Ref.
Analog Reference AI16
%A.I.16 Sym. Speed Limit Ref.
Analog Reference AI1
%A.I.1 Neg. Speed Limit Ref.
Analog Reference AI2
%A.I.2 Neg. Speed Limit Ref.
Analog Reference AI3
%A.I.3 Neg. Speed Limit Ref.
Analog Reference AI16
%A.I.16 Neg. Speed Limit Ref.
Command Reference
% SUM Neg. Speed Limit Ref.
PRC_SPD_TOT_AN_NEG (D83)

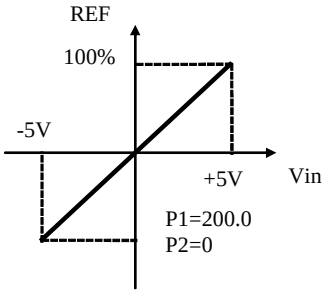
For example in the case of A.I.1, the result of the conditioning is given by the following equation:

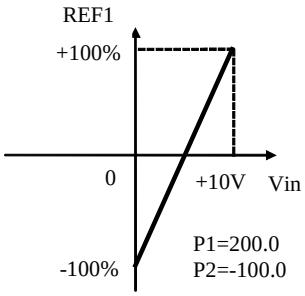
REF1= ((A.I.1/10)*P1) + P2

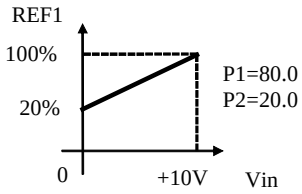
By selecting a suitable correction factor and offset the most varied linear relationships can be obtained between the input signal and the reference generated, as exemplified below.

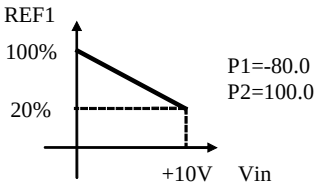


Default setting









Note: for the offset parameters (P02, P04 and P06) an integer representation has been used on the basis of 16383, in order to obtain maximum possible resolution for their settings.

For example if P02=100 ⇨ offset = 100/16383 = 0.61%

As said above, the enabling of each analog input is independent and can be set permanently by using the corresponding connection or can be controlled by a logic input after it has been suitably configured. For example to enable input **A.I.1** the connection **E00** or the input logic function **I03** can be used, with the default allocated to logic input 3.
The parameters E03÷E05 and E08 are used to separately configure the analog inputs available:

E03 ÷ E05 and E08	Description
0	Speed ref.
1	Torque ref.
2	Symmetrical Torque limit ref.
3	Positive Torque limit ref.
4	Negative Torque limit ref.
5	Symmetrical Speed limit ref.
5	Manual set point PID
6	Positive Speed limit ref.
7	Negative Speed limit ref.

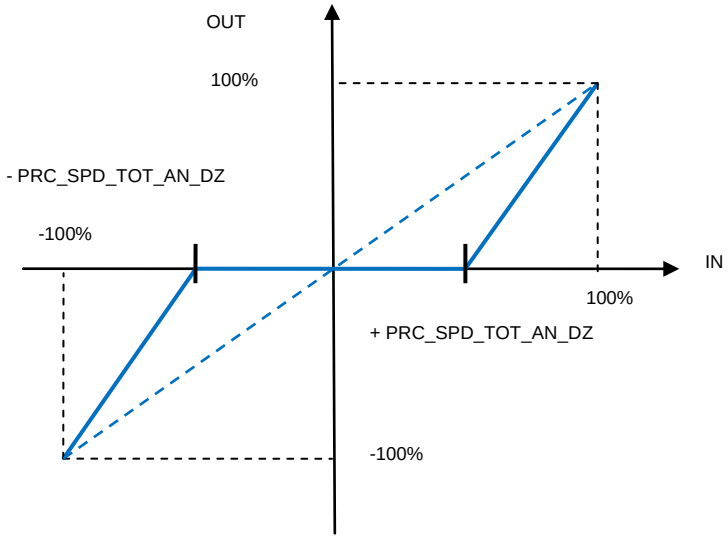
Several inputs can be configured to the same meaning so that the corresponding references, if enabled, will be added together.

Note: using the appropriate multiplicative coefficient for each reference it is therefore possible to execute the subtraction of two signals.
In the case of the torque limit, if there is no analog input configured to the given meaning and enabled, the reference is automatically put at the maximum that can be represented, i.e. 400%. In internal quantities d32 it is possible to view the torque limit imposed by the application.

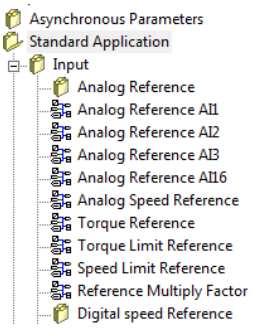
In the case of the torque reference there is a first order filter with time constant that can be set in milliseconds in parameter E06. In the internal quantity d10 the torque reference can be viewed as set by the application

3.1.3 Dead Zone

This function allows to set a zone ("*dead zone*") where the analog reference is automatically set to 0. To enable the dead zone, set the parameter **E09** "PRC_SPD_TOT_AN_DZ" to a value different to zero.
When the analog reference is less than E09 his value is automatically set to 0, when reference is greater than **E09** the value is scaled with input range from **E09**=0% to 100%.
The following scheme shows the situation. The dead zone is symmetric.

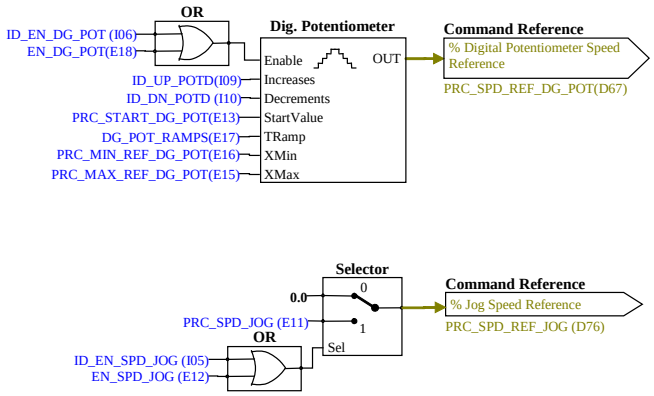


3.1.4 Digital Speed Reference



Name	Description	Min	Max	Default	UM	Scale
PRC_SPD_JOG	E11 - Digital speed reference value (JOG1)	-100.00	100.00	0	% MOT_SPD_MAX	163.84
EN_SPD_JOG	E12 - Enable jog speed reference	0	1	0		1
PRC_SPD_REF_JOG	D76 - Jog Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_START_DG_POT	E13 - Motor potentiometer starting speed	-100.0	100.0	2.002075	% MOT_SPD_MAX	163.84
EN_MEM_DG_POT	E14 - Load final digital potentiometer reference value	0	1	0		1
PRC_MAX_REF_DG_POT	E15 - CW motor potentiometer speed reference value	-105.02	105.02	105.02	% MOT_SPD_MAX	163.84
PRC_MIN_REF_DG_POT	E16 - CCW motor potentiometer speed reference value	-105.02	105.02	-105.02	% MOT_SPD_MAX	163.84
DG_POT_RAMPS	E17 - Digital potentiometer acceleration time	0.3	1999.9	50	s	10
EN_DG_POT	E18 - Enable motor potentiometer reference value	0	1	0		1
PRC_SPD_REF_DG_POT	D67 - Digital Potentiometer Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_APP_SPD_REF	D33 - Speed reference (application generated)	-100	100	0	% MOT_SPD_MAX	163.84

Digital Speed References



3.1.4.1 Digital Speed Reference (Jog)

The value programmed in parameter **E11** can be used as digital speed reference either by activating the logic function “Enable Jog” I.05 assigned to an input (default input L.I.5) or with the connection **E12**=1. The resolution is 1/10000 of the maximum working speed.

3.1.4.2 Digital Potentiometer Speed Reference

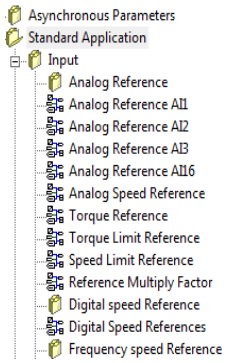
A function that makes it possible to obtain a terminal board adjustable speed reference through the use of two logic inputs to which are assigned the input functions digital potentiometer up **I09**” (ID_UP_POTD) and “Digital potentiometer down **I10**” (ID_DN_POTD) .
The reference is obtained by increasing or decreasing an internal counter with the ID_UP_POTD and ID_DN_POTD functions respectively.
The speed of increase or decrease set by parameter **E17** (acceleration time of the digital potentiometer) which sets how many seconds the reference takes to go from 0 to 100%, keeping the ID_UP_POTD active (this times is the same as to go from 100.0% to 0.0% by holding ID_DN_POTD active). If ID_UP_POTD are ID_DN_POTD are activated at the same time the reference remains still.
The movement of the reference is only enabled when the converter is in RUN.
The functioning is summarised in the following table :

Converter running on-line	ID_UP_POTD	ID_DN_POTD	DP.LV	C20	REF
H	H	L	x	x	increases
H	L	H	x	x	decreases
H	L	L	x	x	stopped
H	H	H	x	x	stopped
L	x	x	x	x	stopped
L -> H	x	x	L	L	P8
L -> H	x	x	H	L	REF4 L.v.
L -> H	x	x	L	H	REF4 L.v.
L -> H	x	x	H	H	REF4 L.v.

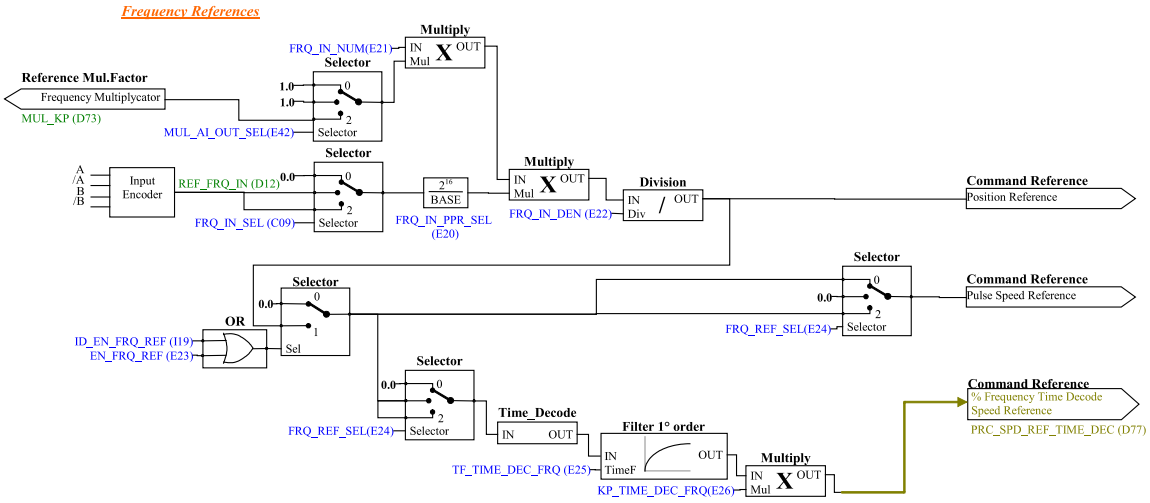
H = active x = does not matter L = not active L -> H = From Off-line to On-line

The digital potentiometer reference requires, to be enabled, activation of function **I06** after allocating an input or activating connection **E18** (E18=1) .
In the parameters **E15** and **E16** the maximum and the minimum admitted reference values can be marked for the digital potentiometer reference.

3.1.5 Frequency Speed Reference



Name	Description	Min	Max	Default	UM	Scale
FRQ_IN_SEL	C09 - Frequency input setting	Range 0 Analogic 1 Digital Encoder 2 Digital f/s 3 Digital f/s 1 edge		1		1
FRQ_IN_PPR_SEL	E20 - Encoder pulses per revolution	Range 0 Not enabled 1 64 ppr 2 128 ppr 3 256 ppr 4 512 ppr 5 1024 ppr 6 2048 ppr 7 4096 ppr 8 8192 ppr 9 16384 ppr		5		1
FRQ_IN_NUM	E21 - NUM - Frequency input slip ratio	-16383	16383	100		1
FRQ_IN_DEN	E22 - DEN - Frequency input slip ratio	0	16383	100		1
REF_FRQ_IN	D12 - Frequency in input			0	KHz	16
FRQ_REF_SEL	E24 - Frequency speed reference selection	Range 0 Frequency only 1 Time decod only 2 Frequency and time decod		0		1
EN_FRQ_REF	E23 - Enable frequency speed reference value	0	1	0		1
TF_TIME_DEC_FRQ	E25 - Filter time constant of frequency input decoded in time	0.0	20.0	1.6	ms	10
KP_TIME_DEC_FRQ	E26 - Corrective factor for frequency input decoded in time	0.0	200.0	100		163.84
PRC_SPD_REF_TIME_DEC	D77 - Time Decode Frequency input Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_APP_FRQ_SPD_REF	D14 - Frequency speed reference value (application generated)	-100	100	0	% MOT_SPD_MAX	163.84
MAXV_VF	P88 - High precision analog speed reference value: Voltage matches max. speed	2500	10000	10000	mVolt	1
OFFSET_VF	P10 - Offset for high precision analog reference value	-19999	19999	0	1/100 mV	1
KP_NEG_VF	P159 - High precision analog speed reference value:VCO setting for negative voltage reference values	-16383	16383	4096		1
KP_POS_VF	P150 - High precision analog speed reference value:VCO setting for positive voltage reference values	-16383	16383	4096		1



3.1.5.1 Speed Frequency Reference Management

This speed reference in pulses can be provided in 4 different ways (alternatives to each other), that can be selected by means of connection C09.

C09	Description	Mode of working
0	*Analogic*	Analog reference ±10V (optional)
1	Digital encoder	4 track frequency reference (default)
2	Digital f/s	Frequency reference (freq. and up/down) counting all edges
3	Digital f/s 1 edge	Frequency reference (freq. and up/down) counting one edge

To be used Speed reference in pulses must be enabled either by activating the function " Enable reference in frequency **I19** "assigned an input or by means of connection **E23**=1 .
The incremental position reference is always enabled and it's possible to add an offset depending on analog and digital speed reference enable.

3.1.5.2 Digital Frequency Reference

About the digital frequency reference, there are two working modes can be selected with C09:
Setting **C09 = 1** a reference can be provided with an encoder signal with 4 tracks of a maximum range varying between 5V and 24V and a maximum frequency of 300KHz.

Setting C09 = 2 a speed reference can be provided with an frequency signal with a maximum range varying between 5V and 24V and a maximum frequency of 300KHz.
(setting C09 =3 will be manage the same input, but internally will be count only rising edge, this option is useful only if it is used the time decode)

The number N of impulses/revolution for the reference is set by connection **E20**:

N	0	1	2	3	4	5	6	7	8	9
N° of impulses/revolution	Disable	64	128	256	512	1024	2048	4096	8192	16384

There are the parameters **E21** and **E22** that permit specification of the ratio between the reference speed and input frequency as a Numerator/Denominator ratio.
In general terms, therefore, if you want the speed of rotation of the rotor to be X rpm, the relationship to use to determine the input frequency is the following:

$$f = \frac{\mathcal{X} \times N_{pulse\ revolution} \times E22}{60 \times E21}$$

and vice versa

$$\mathcal{X} = \frac{f \times 60 \times E21}{N_{pulse\ revolution} \times E22}$$

Let us now look at a few examples of cascade activation (MASTER SLAVE) with frequency input according to a standard encoder.
By a MASTER drive the simulated encoder signals A,/A,B,/B are picked up to be taken to the frequency input of the SLAVE. By means of parameters E21 and E22 the slipping between the two is programmed.

Master	Slave
N° of pulses/revolution = 512	N° of pulses/revolution = 512
P65 = 2500 rpm	P65 = 2500 rpm
	E21 = E22 = 100

Master	Slave
N° of pulses/revolution = 512	N° of pulses/revolution = 512
P65 = 2500 rpm	P65 = 2500 rpm
	E21 = 50 E22 = 100
The slave goes at the half speed as the master	

Master	Slave
N° of pulses/revolution = 512	N° of pulses/revolution = 512
P65 = 2500 rpm	P65 = 2500 rpm
	E21 = 100 E22 = 50
The slave goes at the double speed as the master	

To obtain good performance at low speed it is necessary to select an encoder resolution for the master that sufficiently high.
More precisely, the signal coming from the encoder can be adapted according to the report E21/E22 and, if necessary, one of the analog input

3.1.5.3 Frequency Speed Reference Management

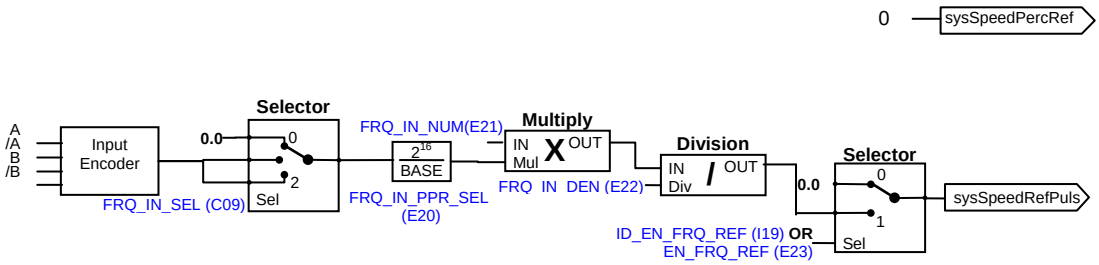
The speed reference in pulses is very accurate (no pulses is lost) but for its nature it has an irregular shape because are counted the edges every sampling period (TPWM) and this produce a speed reference with many noise. Also if the frequency input is constant, between a PWM period and another could be counted a variable number of pulses, ± one pulse. This produce a low resolution reference, expecially when the frequency input decreases.
For not use a big filter with frequency reference it's possible to use its time decode that has a good resolution. It is measured the time between various edges of frequency input with resolution of 25ns, reaching a percentage resolution not less than 1/8000 (13 bit) working to 5KHz of PWM (increasing PWM resolution decreases linearly).

There are 3 different ways to manage frequency speed reference, selectable with parameter **E24** (FRQ_REF_SEL):

E24	Description
0	Pulses reference
1	Decoded in time reference
2	Pulses and decoded in time reference

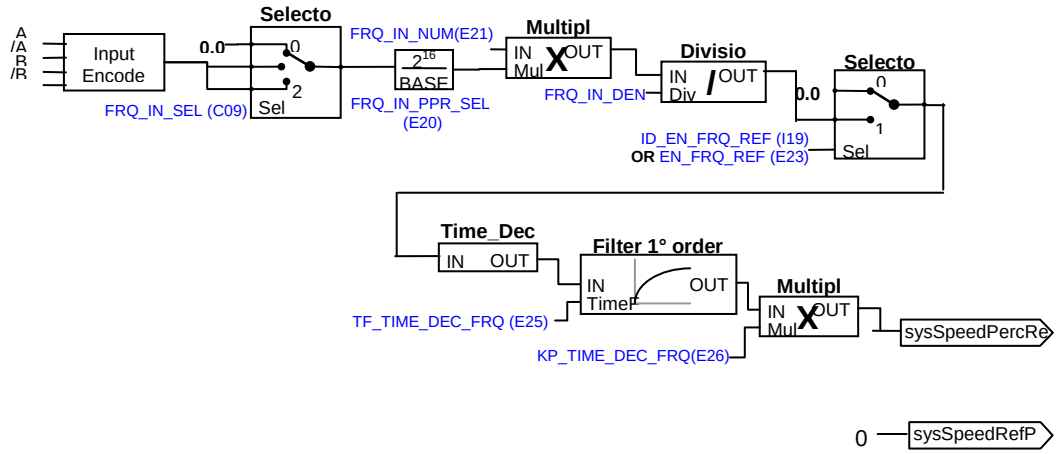
Enabling the frequency speed reference can be done by the parameter E23 = 1 (EN_FRQ_REF) or bringing at active logic state input function I19.

3.1.5.3.1 Pulses Reference (E24=0)



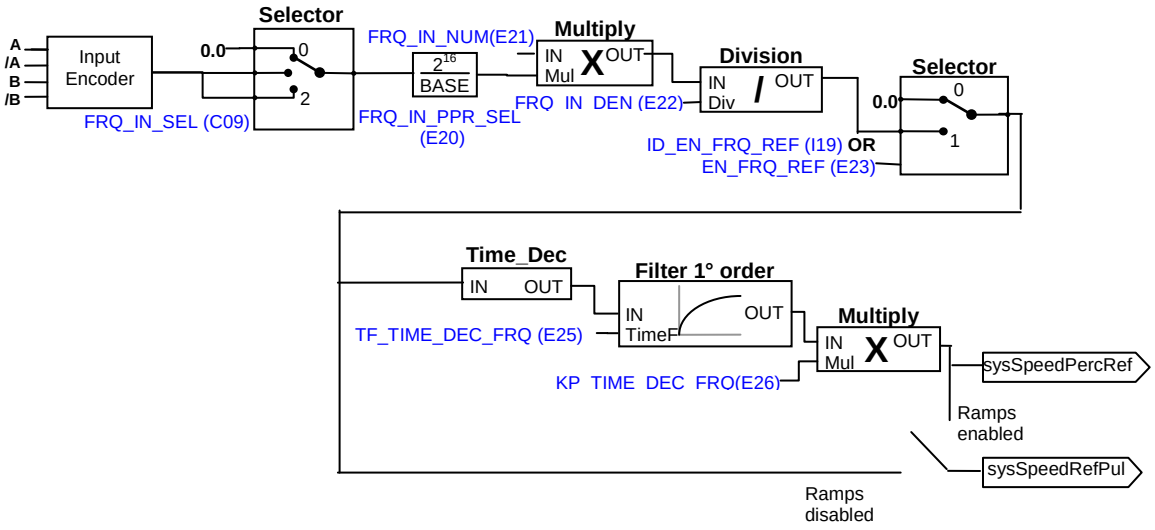
In this mode, the speed reference is given only in pulses ensuring maximum correspondence master-slave, but with a strong granular signal especially for low frequency input.
Linear ramps are not enabled.

3.1.5.3.2 Decoded In Time Reference (E24=1)



In this working mode the frequency speed reference is decoded in time with maximum linearity also for very low input frequencies.
In this mode is possible to create a dynamic electrical axis, possibly with linear ramps enabled, but that is not rigid in the sense that there is no guarantee master-slave phase maintenance.

3.1.5.3.3 Pulses and Decoded in Time Reference (E24=2)



This is the most complete and powerful mode, which makes use of both references:

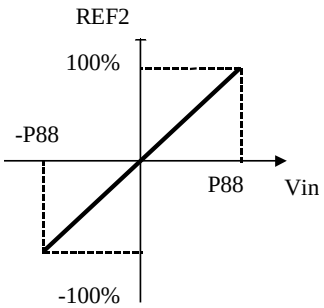
- the frequency speed reference decoded in time ("sysSpeedPercReference") has very good resolution also for low frequency input, thus allows high speed regulator gains
- the pulses speed reference ("sysSpeedRefPulses "), going to impose a reference to the integral part of the speed regulator, will not miss pulses, ensuring maximum precision in the master-slave electrical axes

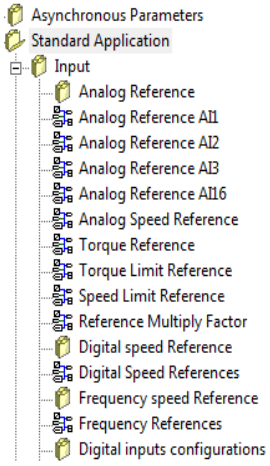
If the linear ramps are enabled will act only after the first starting, then going to exclude themselves.

3.1.5.3.4 High Resolution Analog Reference (Optional)

Putting **C09 = 0** (with the optional hardware) an analog signal can be provided ±of 10V that will be converted into frequency while impulse counting will be taken from the high precision speed reference. Parameter **P10** permits compensation of any offset present in the analog input and is expressed in units of 10μV;

Parameter **P88** permits setting of the voltage to which maximum speed will correspond (default value of 10000mV or 10V).





3.1.6 Digital Inputs Configurations

The control requires up to 8 optically insulated digital inputs (L.I.1 … L.I.8.) whose logic functions can be configured by means of connection **C1** ÷ **C8**.

Name	Description	Min	Max	Default	UM	Scale
LI1_SEL	C01 - Meaning of logic 1	-1	31	8		1
LI2_SEL	C02 - Meaning of logic 2	-1	31	2		1
LI3_SEL	C03 - Meaning of logic 3	-1	31	3		1
LI4_SEL	C04 - Meaning of logic 4	-1	31	0		1
LI5_SEL	C05 - Meaning of logic 5	-1	31	4		1
LI6_SEL	C06 - Meaning of logic 6	-1	31	12		1
LI7_SEL	C07 - Meaning of logic 7	-1	31	5		1
LI8_SEL	C08 - Meaning of logic 8	-1	31	22		1
TF_LI6-7-8	P15 - I06,07,08 logical inputs digital filter	0.0	20.0	2.2	ms	10
EN_NOT_LI	C79 - Enable negative logic for digital inputs	0	255	0		1

The following table shows the logic functions managed by standard application:

		NAME	INPUT LOGIC FUNCTIONS	DEFAULT INPUT	DEFAULT STATUS
I	00	ID_RUN	Run command	L.I.4	L
I	01	ID_CTRL_TRQ	Torque control		L
I	02	ID_EN_EXT	External enable	L.I.2	H
I	03	ID_EN_SPD_REF_AN	Enable analog reference A.I.1.	L.I.3	L
I	04	ID_EN_TRQ_REF_AN	Enable analog reference A.I.2.	L.I.5	L
I	05	ID_EN_JOG	Enable speed jog	L.I.7	L
I	06	ID_EN_SPD_REF_POTD	Enable digital potentiometer speed reference		L
I	07	ID_EN_LIM_TRQ_AN	Enable analog reference A.I.3.		L
I	08	ID_RESET_ALR	Reset alarms	L.I.1	L
I	09	ID_UP_POTD	Digital potentiometer UP		L
I	10	ID_DN_POTD	Digital potentiometer DOWN		L
I	11	ID_LAST_V_POTD	Load last digital potentiometer value		L
I	12	ID_INV_SPD_REF	Invert speed reference value	L.I.6	L
I	14	ID_EN_FLDB_REF	Enable FIELD-BUS reference values		L
I	15	ID_EN_PID_REF	Enable PID ref		
I	16	ID_EN_PAR_DB2	Enable second parameter bank		L
I	17	ID_EN_LP_SPZ_AXE	Enable space loop for electrical axis		L
I	18	ID_FRZ_COM_I	Freeze integral part of PID		
I	19	ID_EN_SPD_REF_FRQ	Enable frequency speed reference value		L
I	20	ID_EN_AI16	Enable analog reference value AI16		L
I	21	ID_EN_OVR_LMN_I	Enable override integral part of PID		
I	22	ID_EN_RAMP	Enable liner ramps	L.I.8	L
I	23	ID_TC_SWT_MOT	Motor termo-switch		L
I	24	ID_BLK_MEM_I_SPD	Freeze PI speed regulator integral memory		L
I	25	ID_EN_OFS_LP_SPZ	Enable offset on overlap position loop reference		L
I	26	ID_EN_SB	Enable speed regulator second bank		L
I	27	ID_POS_SEL0	Stop in position target selection (bit0)		L
I	28	ID_POS_SEL1	Stop in position target selection (bit1)		
I	29	ID_EN_POS	Enable Stop in position function		
I	30	ID_EN_POS_NOV	Enable Stop in position movement		
I	31	ID_PWM_SYNCH	PWM synchronization input		

NB: pay particular attention to the fact that it is absolutely not possible to assign the same logic function to two different logic inputs: after changing the connection value that sets a determined input, check that the value has been accepted, if not check that another has not already been allocated to that input. In order to disable a logic input it's necessary to assign to it the logic function -1 : this is the only value that can be assigned to more than one inputs.
For example, to assign a specific logic function to logic input 1 you must first write the desired logic number for connection I01 :

I01 = 14 → logic input 1 can be used to enable Fieldbus references

The logic functions that have been configured become active (H) when the input level is at high status (20V < V < 28V), and there is a 2.2ms hardware filter. With the connection **C79** it's possible to enable the active logic low state for a particular digital input, it's necessary to sum 2 to the power of ordinal input number.

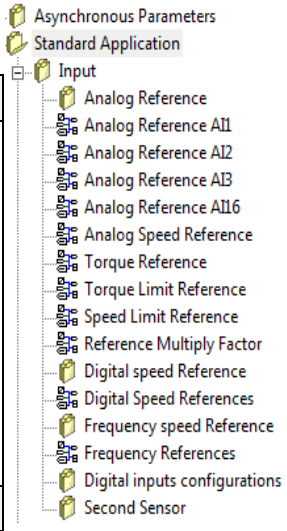
For example to set digital inputs I0 and I3 to active low state, set: $C79 = 2^0 + 2^3 = 9$
The functions that have not been assigned assume default value ; for example, if the function "external enable" is not assigned it becomes, as default, "active (H)" so the converter is as if there were no assent from the field

3.1.6.1 Input Logic Functions Set in Other Ways

In reality the input logic functions can also be set by serial connection and by fieldbus, with the following logic:

I00 Run : stands alone, it has to be confirmed by terminal board inputs, by the serial and by the fieldbus, though in the case of the latter the default is active and so, if unaltered, controls only the terminal board input.
I01÷ I31: is the parallel of the corresponding functions that can be set at the terminal board, the serial or the fieldbus

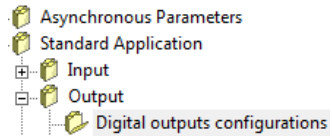
3.1.7 Second Sensor



Name	Description	Min	Max	Default	UM	Scale
SENSOR2_SEL	C17 - Sensor2 selection	Range 0 1 Encoder 2 3 4 Resolver 5 Resolver RDC 6 7 8 Sin/Cos incr 9 10 Endat 1317 11 Endat 1329 12 13 14 Endat 125		0		1
RES2_POLE	P16 - Number of absolute sensor2 poles	1	160	2		1
ENC2_PPR	P17 - Number of encoder2 pulses/revolution	0	60000	1024	pulses/rev	1
EN_TIME_DEC_ENC2	C18 - Enable incremental encoder2 time decode	0	1	0		1
EN_INV_POS2_DIR	C20 - Invert sensor2 positive cyclic versus	0	1	0		1
EN_SENSOR2_TUNE	U00 - Enable sensor2 autotunig	0	1	0		1
RES2_TRACK_LOOP_BW	P48 - Tracking loop bandwidth direct decoding of resolver2	100	10000	1800	rad/s	1
RES2_TRACK_LOOP_DAMP	P49 - Damp factor Traking loop resolver2	0.00	5.00	0.71		100
KP_SENS2	P07 - Second sensor amplitude compensation	0.0	200.0	100	%	163.84
OFFSET_SIN_SENS2	P08 - Second sensor sine offset	-16383	16383	0		1
OFFSET_COS_SENS2	P09 - Second sensor cosine offset	-16383	16383	0		1
HW_SENSOR2	D62 - Sensor2 presence			0		1
SENS2_SPD	D51 - Second sensor rotation speed			0	rpm	1

Name	Description	Min	Max	Default	UM	Scale
SENS2_TURN_POS	D52 - Second sensor Absolute mechanical position (on current revolution)			0	16384	1
SENS2_N_TURN	D53 - Second sensor Number of revolutions			0	16384	1
SENS2_FRQ_IN	D54 - Second sensor Frequency input			0	KHz	16
SENS2_ZERO_TOP	D56 - Sensor2 Zero Top			0	pulses	1
RES2_DDC_BW	C25 - Second resolver DDC bandwidth	0	1	0	Hz	1
EN_SLOT_SWAP	C19 - Enable sensor slot swap	Range 0 No 1 Yes		0		1
SENS2_RES	Second sensor resolution			0	bit	1
SENS2_POS	Second sensor actual position			0	sensor pulses	1

3.2 OUTPUT



3.2.1 Digital Output Configurations

The control can have up to 4 optically insulated digital outputs (L.O.1 ... L.O.4) whose logic functions can be configured as active high (H) by means of connection **C10** ÷ **C13**.

Name	Description	Min	Max	Default	UM	Scale
LO1_SEL	C10 - Meaning of logic output 1	-64	63	3		1
LO2_SEL	C11 - Meaning of logic output 2	-64	63	0		1
LO3_SEL	C12 - Meaning of logic output 3	-64	63	6		1
LO4_SEL	C13 - Meaning of logic output 4	-64	63	19		1
I_RELAY_SEL	C55 - Current relay output	Range 0 I/I NOM MOT 1 T/T NOM POT 2 P/P NOM POT		0		1
I_RELAY_THR	P26 - Current/power relay cut-in threshold	0.2	150.0	100	%	40.96
TF_I_RELAY	P27 - Filter time constant for current/power relay	0.1	10.0	1	s	10
DO_SPD_REACH_THR	P47 - Speed threshold for logic output o.16	0.0	100.0	0	%MOT_SPD_MAX	163.84
DO_SPD_MIN_THR	P50 - Minimum speed for relay	0.0	100.0	2.0	%MOT_SPD_MAX	163.84
HYST_DO_SPD	P59 - Minimum anda maximum speed reached output hysteresis	0.0	100.0	1.0	%MOT_SPD_MAX	163.84

The following table shows the logic functions managed by standard application:

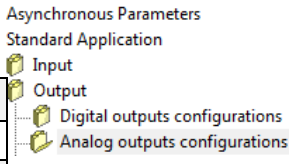
		NAME	OUTPUT LOGIC FUNCTIONS	DEFAULT OUTPUT
O	00	OD_DRV_READY	Drive ready	L.O.2
O	01	OD_ALR_KT_MOT	Motor thermal alarm	
O	02	OD_SPD_OVR_MIN	Speed greater than minimum	L.O.4
O	03	OD_DRV_RUN	Drive running	L.O.1
O	04	OD_RUN_CW	CW / CCW	
O	05	OD_K_I_TRQ	Current/torque relay	
O	06	OD_END_RAMP	End of ramp	L.O.3
O	07	OD_LIM_I	Drive at current limit	
O	08	OD_LIM_TRQ	Drive at torque limit	
O	09	OD_ERR_INS	Tracking incremental error > threshold (P37 and P39)	
O	10	OD_PREC_OK	Power soft-start active	

O	11	OD_BRK	Braking active	
O	12	OD_POW_OFF	No mains power	
O	13	OD_BUS_RIG	Bus regeneration enable (Support 1)	
O	14	OD_IT_OVR	Motor overheating (exceeds threshold P96)	
O	15	OD_KT_DRV	Radiator overheating (higher than P120 threshold)	
O	16	OD_SPD_OK	Speed reached (absolute value higher than P47)	
O	17	OD_STO_ON	Safe Torque Off active	
O	19	OD_POS_INI_POL	Regulation card supplied and DSP not in reset state	
O	20	OD_SNS1_ABS	SENS1 Absolute position available	
O	21	OD_DRV_OK	Drive ready and Power Soft start active	
O	22	OD_LL_ACTV	LogicLab application active	
O	23	OD_STO_OK	STO: not dangerous failure	
O	24	OD_TRQ_CTRL	Torque control	
O	25	OD_VBUS_OK	DC bus voltage exceeds threshold (P79)	
O	26	OD_BRK_FLT	Braking circuit fault (MiniOPDE only)	
O	31	OD_PWM_SYNCH	PWM synchronization output	
O	32	OD_HLD_BRK	Motor holding brake	
O	33	OD_STOP_POS_ON	Stop in position target reached	
O	34	OD_SPD_REF_RCH	Speed reference reached	
O	39	OD_EN_FANS	Enable converter fans	

If you wish to have the logic outputs active at the low level (L) you need just configure the connection corresponding to the chosen logic function but with the value denied: for example, if you want to associate the function " end of ramp " to logic output 1 active low, you have to program connection 10 with the number -6 (C10=-6).

Note: if you want to configure Output logic 0 to active low you have to set the desired connection to value -32

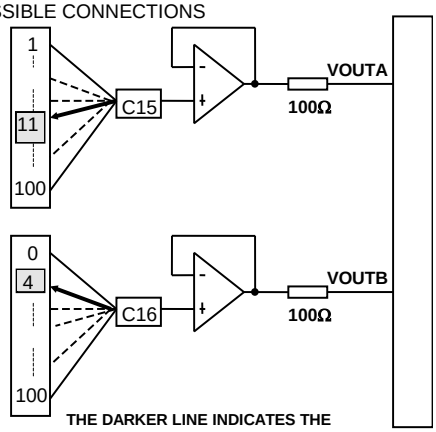
3.2.2 Analog Output Configurations



Name	Description	Min	Max	Default	UM	Scale
AO1_SEL	C15 - Meaning of programmable analog output 1	-99	100	11		1
AO2_SEL	C16 - Meaning of programmable analog output 2	-99	100	4		1
PRC_AO1_10V	P57 - % value of 10V for analog output A	100.0	400.0	200	%	10
PRC_AO2_10V	P58 - % value of 10V for analog output B	100.0	400.0	200	%	10
OFFSET_AO1	P110 - Offset A/D 1	-100.0	100.0	0	%	327.67
OFFSET_AO2	P111 - Offset A/D 2	-100.0	100.0	0	%	327.67

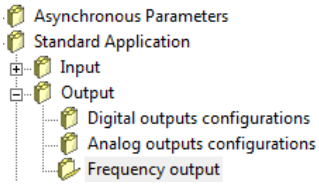
There can be a maximum of two analog outputs, VOUTA and VOUTB ±10 V, 2mA.
To each of the two outputs can be associated an internally regulated variables selected from the list here below; the allocation is made by programming the connection corresponding to the output concerned, **C15** for VOUTA and **C16** for VOUTB, with the number given in the table below corresponding to the relative quantities. By means of the parameters **P57** (for VOUTA) and **P58** (for VOUTB) it is also possible to set the percentage of the variables selected to correspond to the maximum output voltage (default values are P57=P58=200% so 10V in output correspond to 200% of variable selected). The default for VOUTA is a signal proportional to the current supplied by converter (C15=11), in VOUTB the signal is proportional to the working speed (C16=4).
It is also possible to have the absolute internal variable value desired: to do this it is simply necessary to program the connection corresponding to the denied desired number: for example taking C15=-21 there will be an analog output signal proportional to the absolute value of the working frequency.
It is also possible to have a analog output fixed to +10V: to do this it is simply necessary to program the connection corresponding to 100.

POSSIBLE CONNECTIONS



		OUTPUT ANALOG FUNCTIONS	DEFAULT OUTPUT
O	00	Actual mechanical position read by sensor[100%=180]	
O	01	Actual electrical position read by sensor(delta m) [100%=180]	
O	02	Reference speed value before ramps [% n mAX]	
O	03	Reference speed value after ramps [% n MAX]	
O	04	Rotation speed filtered [% n MAX]	A.0.2
O	05	Torque request [% C NOM MOT]	
O	06	Internal value: status (MONITOR only)	
O	07	Request to current loop for torque current [% I NOM AZ]	
O	08	Request to current loop for flux current [% I NOM AZ]	
O	09	Max voltage available [% VNOM MOT]	
O	10	Internal value: alarms (MONITOR only)	
O	11	Current module [% I NOM AZ]	A.0.1
O	12	Motor sensor Zero Top [100%=180]	
O	13	U phase current reading [% I MAX AZ]	
O	14	Internal value: inputs (MONITOR only)	
O	15	Torque component of current reading [% I NOM AZ]	
O	16	Magnetizing component of current reading [% I NOM AZ]	
O	17	U phase voltage duty-cycle	
O	18	Stator voltage reference value module [% VNOM MOT]	
O	19	Modulation index [0<->1]	
O	20	Request Q axis voltage (Vq_rif) [% VNOM]	
O	21	Delivered power [% PNOM]	
O	22	Request D axis voltage (Vd_rif) [% VNOM]	
O	23	Torque produced [% C NOM MOT]	
O	24	DC bus voltage [100%=900V]	
O	25	Radiator temperature	
O	26	Motor temperature	
O	27	Rotor flux [% NOM]	
O	28	Motor thermal current [% alarm threshold A6]	
O	29	Current limit [% I MAX AZ]	
O	30	CW maximum torque [% C NOM MOT]	
O	31	CCW maximum torque [% C NOM MOT]	
O	32	Internal value: outputs (MONITOR only)	
O	33	Internal value: inputs_hw (MONITOR only)	
O	34	V phase current reading [% I MAX AZ]	
O	35	W phase current reading [% I MAX AZ]	

O	36	Actual electrical position (alfa_fi) [100%=180]	
O	37	Analog input A.I.1	
O	38	Analog input A.I.2	
O	39	Analog input A.I.3	
O	40	Positive speed reference limit [% n MAX]	
O	41	Application speed reference value ("sysSpeedPercReference") [% n MAX]	
O	42	Application torque reference value ("sysTorqueReference") [% C NOM MOT]	
O	43	Application positive torque limit ("sysMaxTorque") [% C NOM MOT]	
O	44	Frequency speed reference value from application ("sysSpeedRefPulses") [Pulses per TPWM]	
O	45	Overlapped space loop reference value from application ("sysPosRefPulses")[Pulses per TPWM]	
O	46	Amplitude to the square of sine and cosine feedback signals [1=100%]	
O	47	Sen_theta (Direct resolver and Sin/Cos Encoder) [Max amplitude = 200%]	
O	48	Cos_ theta (Direct resolver and Sin/Cos Encoder) [Max amplitude = 200%]	
O	49	Rotation speed not filtered [% n MAX]	
O	50	Delta pulses read in PWM period in frequency input [Pulses per PWM]	
O	51	Overlapped space loop memory lsw [Electrical pulses (x P67)	
O	52	Overlapped space loop memory msw [Electrical turns (x P67)]	
O	53	Incremental SIN theta Sin/Cos Encoder	
O	54	Incremental COS theta Sin/Cos Encoder	
O	55	End initial reset	
O	56	PTM motor thermal probe	
O	57	PTR radiator thermal probe	
O	58	Pulses read by sensor	
O	59	SENS2 Rotation speed not filtered	
O	60	SENS2 Actual position	
O	61	SENS2 Sin_theta	
O	62	SENS2 Cos_theta	
O	63	SYNC delay measured	
O	64	Application negative torque limit (“sysMaxNegativeTorque”) [%C NOM MOT]	
O	65	Energy dissipated on breaking resistance [joule]	
O	66	IGBT junction temperature [%100°]	
O	67	Negative speed reference limit [%nMAX]	
O	68	Stop in position target [100%=180]	
O	69	Stop in position actual position [100%=180]	
O	70	Stop in position error [100%=180]	
O	71	Stop in position o33 timer [ms]	
O	85	Setpoint PID	
O	86	Process value PID	
O	87	Component P of PID	
O	88	Component I of PID	
O	89	Component D of PID	
O	90	Error SP-PV of PID	
O	91	Output PID	



3.2.3 Frequency Output

Name	Description	Min	Max	Default	UM	Scale
ENC_OUT_ZERO_TOP	C49 - TOP zero phase for simulated encoder	0	3	0		1
ENC_OUT_DIR	C50 - Invert channel B simulated encoder	0	1	0		1
ENC_OUT_PPR_SEL	C51 - Choose pulses rev. simulated encoder	0	12	5		1
ENC_OUT_SEL	C52 - Simulated encoder selection	0	5	0		1
OPD_ENC_OUT_SEL	C54 - Internal simulated encoder selection	0	2	0		1
PRC_ENC_OUT_LOOP	P124 - Simulated encoder Kv gain multiplication coeff.	0.0	100.0	100	%	327.67

With C52 is possible select the signal for the frequency output as indicated in the follow table:

C52	Value	Description
0	OPD_ENC_OUT	The frequency output is the simulated encoder based on motor sensor, that can be configured conforming the follow paragraph
1	SENS1	The frequency output is the squared signal from the motor speed (sensor 1)
2	SENS2	The frequency output is the squared signal from the speed sensor 2
3	FRQ_IN	The frequency output is the squared signal from the frequency input
4	OPD_ZERO_OP	The frequency output is the simulated encoder based on motor sensor, configurable (like C52=0) but only the ZeroTop is the real one (from motor sensor)
5	OPD_ENC_OUT2	The frequency output is the simulated encoder based on second sensor configured confirming the follow paragraph

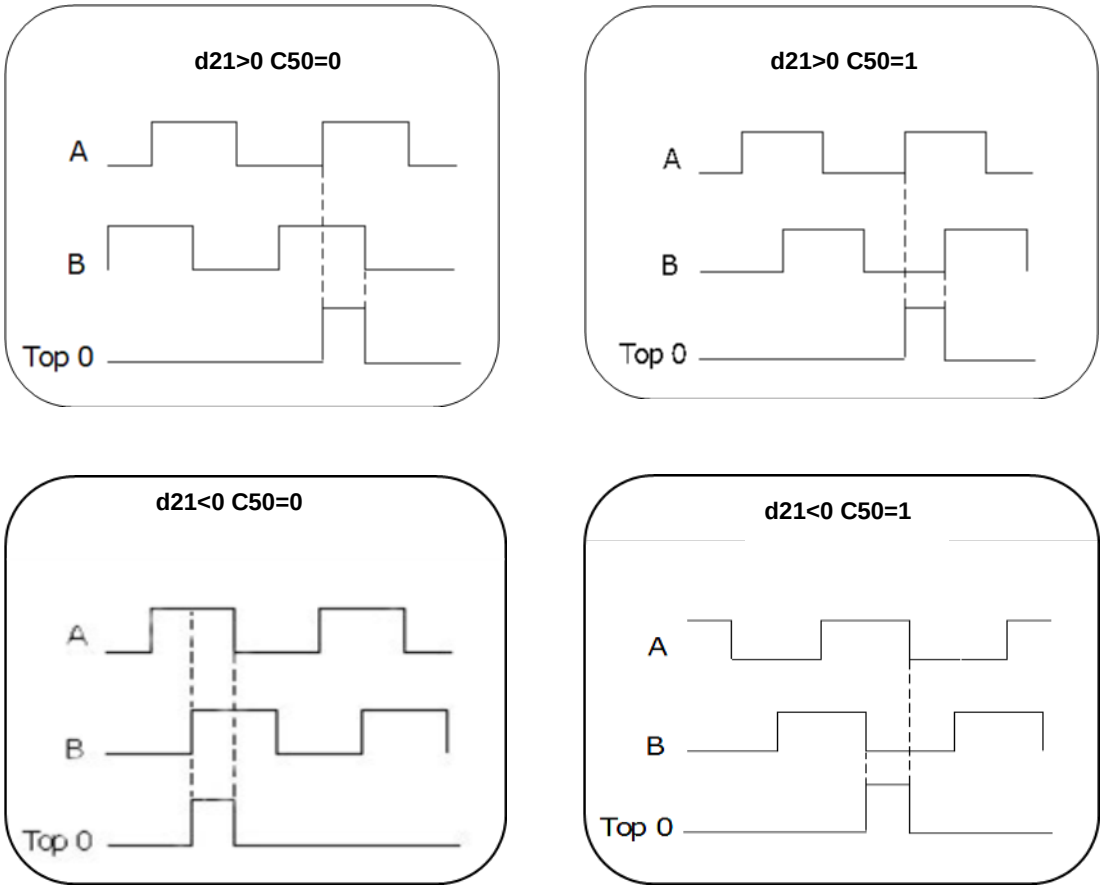
With the default setting (C52=0) is possible to configure the frequency output signals, but there will be a little jitter on the signals for the inner PLL regulation. With C52=1 the output is produced directly from sensor 1 signals. This option, usable only with Encoder or SinCos Encode, ensures a good signal stability (without jitter) but does not allow to choose the number of pulses per revolution in output, since these are those of the sensor.
With C52=1, in the particular case of **Resolver decoded with RDC19224**, the choice of the number of pulses for revolution depends on the maximum speed and the number of sensor polar couples (P68/2) in this way:

Maximum speed (rpm) x P68/2	Pul/rev motor/(P68/2)
1500	16384
6000	4096
24000	1024

With C52=2 the output is produced directly from sensor 2 signals, and with C52=3 the output is equal to frequency input.
With C52=5 is possible to configure the frequency output signals related to second sensor, choosing the number of pulse per revolution with C51.

3.2.3.1 Simulated Encoder Signals

The frequency of the output signals depends on the motor revolutions, the number of sensor poles and the selection made (see connection **C51** in the core file) and their behaviour in time depends on rotation sense (CW or CCW) and on **C50** as shown in the figures below



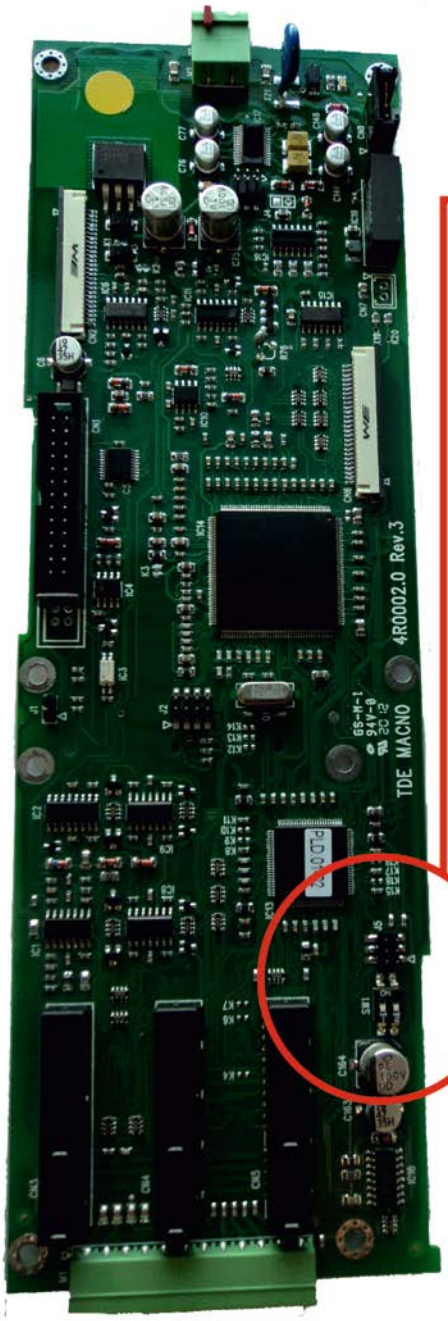
The simulated encoder outputs are all driven by a “LINE DRIVER”. Their level in the standard drive version is referred to +5V and then it is connected to the internal supply (TTL +5V).
In option (to be requested in the ordering) there is the possibility to refer the signal level to an external supply whose value must be between +5V and +24V, connection on terminal 5 and 6.
In the connected device it is better to use a differential input to avoid loops with the 0V wire, to limit noise effects it is better to load this input (10mA max).

It is necessary to use a twisted shielded cable to make a proper connection.

WARNING: the external power supply GND is connected with the 0V of the drive (it is not optoisolated).

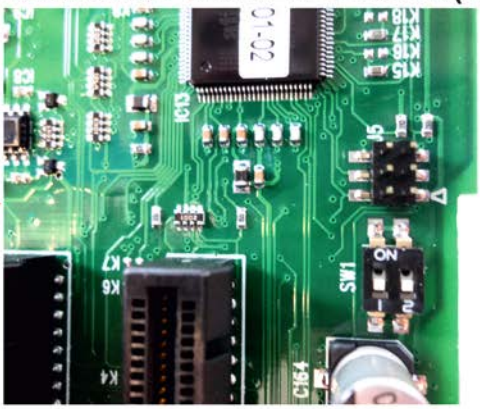
WARNING (MiniOPDE SETTING CONTROL BOARD): see the relevant installation manual.

WARNING: the simulated encoder signals (A,/A,B,/B,C,/C) can exit the connector M4 card regolationto different voltage. In the standard setting of dip switch SW1, as supplied by the BLU [figure (1)], there is the possibilty of supplying a max voltage of 24Vdc to pin M4-5 and M4-6. The signals will come to the same voltage provided at the entrance. With the standard setting, if you don’t provide the voltage on pin M4-5 and M4-6, signals come out at 4,4V. If you want to use the signals to 5V, set the dip switch SW1 as shown in figure(2), without providing any voltage at the terminals M4-5 and M4-6 it may damage the drive.



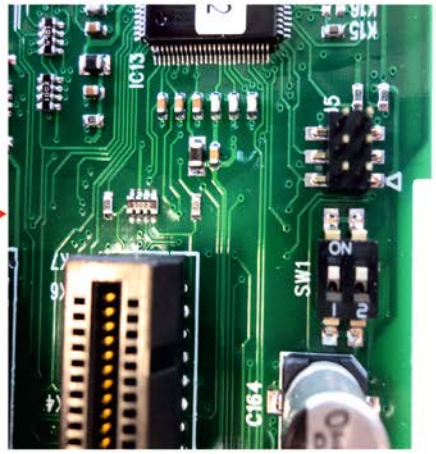
M4

STANDARD DRIVE VERSION(1)



SW1-1 and SW1-2=**OFF**
You can connect max 24Vdc
The channel A,/A, B,/B,C,/C= 24Vdc
M4 connector pin5= 24Vdc
pin6= 0V

CUSTOM DRIVE VERSION(2)



SW1-1 and SW1-2=**ON**
Not connect 24Vdc, connect nothing
The channel A,/A, B,/B,C,/C= 5Vdc
M4 connector pin5= N.C.
pin6= N.C.

3.2.3.2 Configuration of the Encoder Simulation Output

The two bidirectional simulation encoder channels could have a number of pulses per motor revolution selectable with **C51** according to the following table, that also depends on the number of sensor polar couples:

C51	Pul/rev motor/(P68/2)
0	0
1	64
2	128
3	256
4	512
5	1024
6	2048
7	4096
8	8192
9	16384
10	32768
11	65536
12	131072

WARNING: The choice of the number of pulses for revolution depends on the maximum speed and the number of sensor polar couples (P68/2). In the following table are reported this limitation. If it is selected a number of pulses too high compared with the maximum speed it is triggered the alarm A15 code =1.

Maximum speed (rpm) x P68/2	Pul/rev motor/(P68/2)
230	131072
460	65536
920	32768
1840	16384
3680	8192
7360	4096
14720	2048
29440	1024
32767	512

The default value is **C51=5** correspond to 1024 pul/rev.
As can be seen, the number of pulses also depends on the number of sensor poles which are set in parameter **P68**, and, in particular, the above-mentioned values are valid if the sensor is two-pole.
The pulse output is controlled by a line driver (ET 7272); the limitation of the number of pulses regards the maximum speed is done for limit the maximum frequency for channel to 500 KHz.

3.2.3.3 Simulated Encoder Meaning

The **C54** connection allows to select two different modes of working for simulated encoder:

- **Absolute Simulated Encoder C54=0** (default): in this mode also the third channel (zero pulse) is managed.
- **Incremental Simulated Encoder C54=1**: in this mode the simulated encoder channels follow the motor rotation in incremental way and the third channel (zero pulse) looses of meaning
- **Reference Simulated Encoder C54=2:** in this mode the simulated encoder channels follow the speed reference, and the third channel (zero pulse) looses of physical meaning. If the drive doesn't work in torque limit the reference speed follows perfectly the real speed.

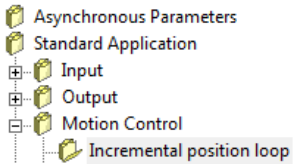
This choice is significant only for sensors with a zero pulse (Encoder, Encoder and Hall sensors, Sin/Cos Encoder), in the other case (Resolver, Endat) the Simulated Encoder is always absolute.
The third channel generates always one zero pulse per revolution.
In the case of multipolar resolver, the zero pulse position depends randomly from the starting position.

The position of the zero pulse depends on the fit of the sensor on the drive shaft; with reference to the original position, decoding the zero of the sensor position, this position may be changed with jumps of 90° electrical (with reference to the sensor) by means of connection **C49** according to the following table:

C49	Displacement
0	+0°
1	+90°
2	+180°
3	+270°

The default value is 0.
These electrical degrees correspond to the mechanical degrees if the resolver has two poles .
Connection **C50** inverts the encoder B channel, thus inverting its phase with respect to channel A, with the same motor rotation direction.
By default **C50**=0
By P124 (default = 100%) is possible to reduce the loop gain. This can increase the stability of the system, but reduce the speed response.

3.3 MOTION CONTROL

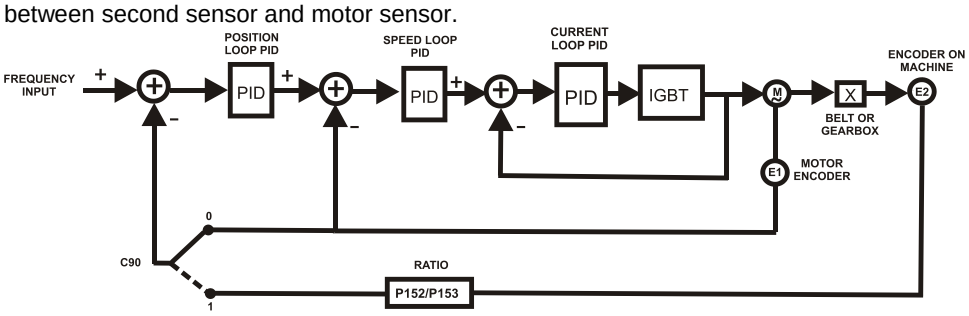


3.3.1 Incremental Position Loop

Name	Description	Min	Max	Default	UM	Scale
FLW_ERR_MAX_LSW	P37 - Maximum tracking error (less significative part)	-32767	32767	32767	ppr	1
POS_REG_KP	P38 - Kv position loop proportional gain	0.0	100.0	4		10
FLW_ERR_MAX_MSW	P39 - Maximum tracking error (less significative part)	0	32767	0	rpm	1
EN_POS_REG	E39 - Enable overlapped space loop	0	1	0		1
EN_POS_REG_MEM_CLR	E40 - Enable overlapped space loop memory clear in stop	0	1	0		1
EN_POS_REG_SENS2	C90 - Enable Incremental Position Loop on second sensor	0	1	0		1
POS_REG_SENS2_NUM	P152 - NUM Second sensor incremental position loop	-16384	16384	100		1
POS_REG_SENS2_DEN	P153 - DEN Second sensor incremental position loop	0	16384	100		1

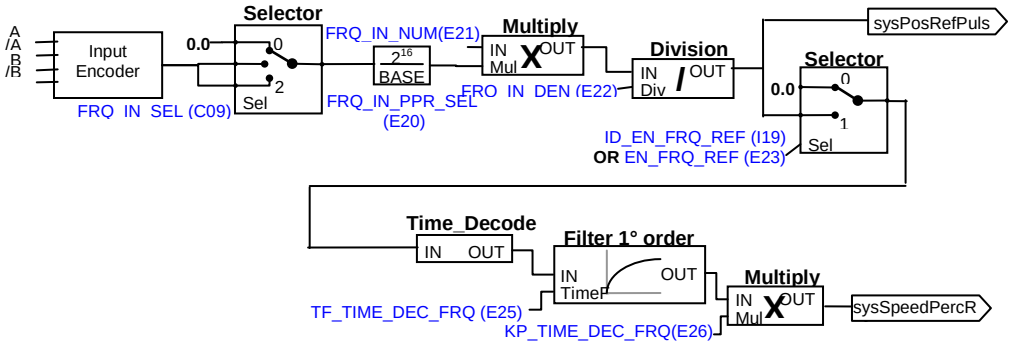
Continuous position control during rotation is used to synchronise both speed and space with the speed reference value used.
To enable this function, set input function **I17** "**Enable overlapped space loop**" to high logic level or set **C239=1**. From then on, an internal counter will be save any position errors regarding the space crossed by the reference value. If the drive RUN command is disabled, the error will be accumulated until it can be corrected once RUN has been enabled again.

Using parameters **P37** (65536=1 mechanical turn) and **P39** (number of mechanical turns) it's possible to set a maximum tracking error threshold, if the absolute error value becomes greater than this value, the logic output **o.9 "Tracking error"** goes at high level.
The overlapped space loop reference value is generated by the application and regards the "sysPosRefPulses" value, which is also expressed in pulses for a period of PWM.
Note that once this function has been enabled, the overlapped space loop reference value will become the real position reference value, while the other speed reference values will represent feed-forward.
With digital logic function I25 ("ID_EN_OFS_LP_SPZ") is possible to add an offset on position reference, based on analog and digital speed reference.
The space loop regulator is a pure proportional gain and its gain can be set on **P38**: set a value that ensures a quick response, but one that does not make the motor vibrate at a standstill.
The continuous position control is most commonly applied to the electric axis: by taking the speed reference value from the MASTER's Simulated Encoder and taking it to the SLAVE's frequency input, the motion of the two motors can be synchronised. Once the overlapped space loop is enabled, the two motors will always maintain the same relative position whatever their load. If the SLAVE reaches its torque limit, the counter will save the position error and then correct it as long as the internal counter limit has not been reached, in which case the synchronisation will be lost.
If "EN_POS_REG_MEM_CLR" (E40) is set to 1 when the drive is in stop the error memory is cleared.
With connection C90 "EN_POS_REG_SENS2" it's possible to enable the use of second sensor to close the incremental position loop. Parameters P152 and P153 are used to set the reduction ration between second sensor and motor sensor.

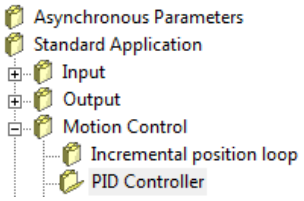


3.3.1.1 Frequency Space Reference (Electrical Axes)

Managing a frequency space reference means always guarantee the same phase angle between master and slave. To do this work is necessary to enable the overlapped position loop with parameter E39 or bringing at active state input function I17.
It should then provide a speed feed-forward reference, the best solution is to use the frequency speed reference decoded in time (E24=1 and E19=0), alternatively, wanting to work in pulses, clear E24=0.
Note: Wanting to manage in space the frequency reference, it's not possible to enable pulses and decoding in time reference(E24 = 2).
The recommended block diagram is:



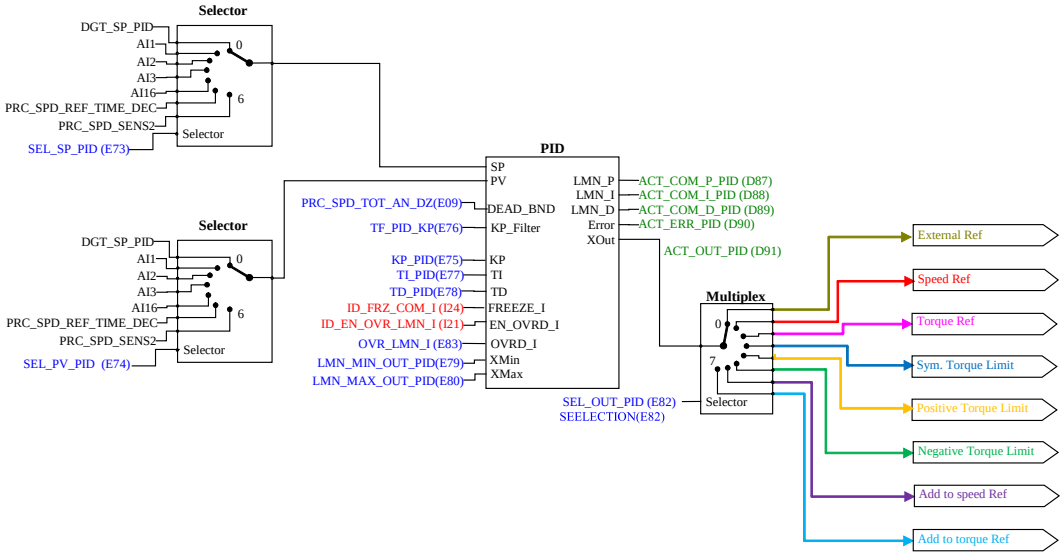
The frequency speed reference decoded in time ("sysSpeedPercReference") has to be enabled with **E23=1** o **I19=H** ,it has very good resolution also for low frequency input, thus allows high speed regulator gains.
The pulses space reference ("sysPosRefPulses") has to be enabled with **C65=1** o **I17=H** from then on will not miss pulses, ensuring maximum precision in the master-slave electrical axes.
Since the overlapped position loop is enabled, it is useless enable also the linear ramps on frequency speed reference decoded in time.



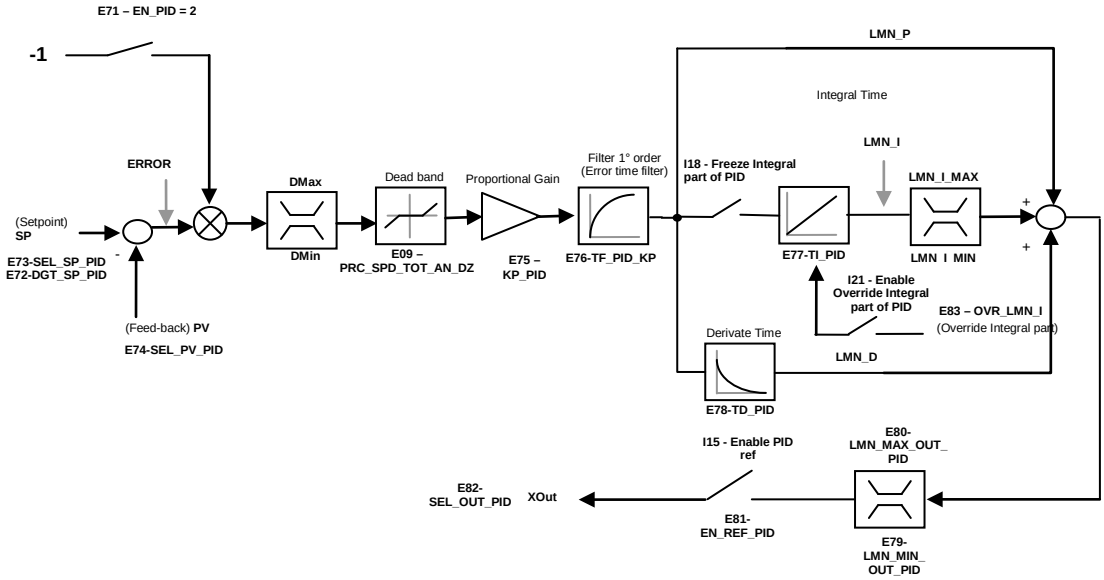
3.3.2 Pid Controller

Name	Description	Min	Max	Default	UM	Scale
EN_PID	E71 - Enabling PID control	0	2	0		1
DGT_SP_PID	E72 - Digital setpoint PID	-200.0	200.0	0.0	%	163.84
SEL_SP_PID	E73 - PID setpoint selection	Range 0 DGT_SP_PID 1 AI1 2 AI2 3 AI3 4 AI16 5 PRC_SPD_REF-TIME_DEC 6 PRC_SPD_SENS2		0		1
SEL_PV_PID	E74 - PID process value selection	Range 0 DGT_SP_PID 1 AI1 2 AI2 3 AI3 4 AI16 5 PRC_SPD_REF-TIME_DEC 6 PRC_SPD_SENS2		1		1
KP_PID	E75 - KP proportional gain	-200.0	200.0	1.00		163.84
TF_PID_KP	E76 - Filter time constant component P PID	0.0	20.0	0.4	ms	10
TI_PID	E77 - TI integral time	0	19999	0	ms	1
TD_PID	E78 - TD derivate time	0	19999	0	ms	1
LMN_MIN_OUT_PID	E79 - Limit Min value of output PID	-200.0	200.0	-100.0	%	163.84
LMN_MAX_OUT_PID	E80 - Limit Max value of output PID	-200.0	200.0	100.0	%	163.84
EN_REF_PID	E81 - Enabling PID reference	0	1	0		1
SEL_OUT_PID	E82 - PID output selection	Range 0 External ref 1 Speed ref 2 Torque ref 3 Symmetrical torque limit ref 4 Positive torque limit ref 5 Negative torque limit ref 6 Add to speed ref 7 Add to torque ref		0		1
ACT_SP_PID	D85 - Actual setpoint PID				%	163.84
ACT_PV_PID	D86 - Actual feed-back PID				%	163.84
ACT_ERR_PID	D90 - Actual error SP-PV of PID				%	163.84
ACT_COM_P_PID	D87 - Actual component P of PID				%	163.84
ACT_COM_I_PID	D88 - Actual component I of PID				%	163.84
ACT_COM_D_PID	D89 - Actual component D of PID				%	163.84
ACT_DUT_PID	D91 - Actual output PID				%	163.84
OVR_LMN_I	E83 - Override integral part of PID	-200.0	200.0	0.0	%	163.84
PRC_SPD_TOT_AN_DZ	E09 - Analog speed/PID error-Dead zone amplitude	0.00	100.00	0	% MOT_SPD_MAX	163.84

PID Control



Below is shown the functional diagram of PID block.



For a better understanding of the PID function it is useful to identify three parts of the controller structure:

- PID input signals. In this section are selected the analog references, Frequency reference and second sensor. The output of this part can be used as input to the PID regulator block.
- PID Regulator Block. This is the PID regulator or controller with its parameter and setting as gains and scaling factors.
- PID output signals . This section is used managing the PID regulator output signal to be used as reference input in the drive.

From the new software release is possible to enable some new functions:

- When the parameter **E71-EN_PID** is se to **2-Enable with Invert Output** the error processed by the PID controller is defined as: Error = PV – SP, In this way the output is reversed compared to the standard behavior,
- Dead zone (defined in the paragraph 3.1.3 pag. 65) allows to put to zero the Error if its value is lower (absolute value) then the dead band limit **E09-PRC_SPD_TOT_AN_DZ**,
- The Logical Input **I18** allows to “freeze” the integral part of PID,
- The Logical Input **I21** allows to overwrite the integral part of PID with the value set in **E83-OVR_LMN_I.**

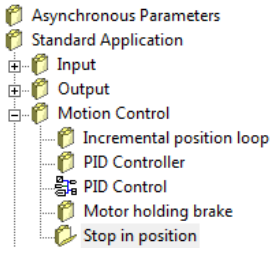
PID Input signals there considers three different possible setting of OPD Explorer: Set Point PID Regulator, Feed back PID Regulator and Manual set point PID Controller.
In all the three different setting the signals coming from the analog inputs AI1,AI2, and AI3, from the frequency input as speed reference and from the second sensor are eventually either added or compared together.
With the exception of the feedback setting the reference can be a digital set point with the appropriate configurations.
With the following premises:

- Input “SP” is the regulation reference with PID enabled (“auto”=TRUE) displayed thru internal value “ACT_SP_PID” (D85)
- Input “PV” is the feedback signal of the regulator with PID enabled (“auto”=TRUE) displayed thru internal value “ACT_PV_PID” (D86)
- Input “KP_Filter” defines the time for the first order filter that acts only on the proportional part
- The PID parameters are:
  - “KP” proportional gain
  - “TI” integral time defined in ms (if set = 0 integral gain is disabled)
  - “TD” derivative time defined in ms (if set = 0 integral gain is disabled)
- Thru inputs “XMAX” (parameter “LMN_MAX_OUT_PID” E80) and “XMIN” (parameter “LMN_MIN_OUT_PID” E79) it is possible to limit the regulation value as “XOUT”. When output “XOUT” reaches its regulation limit the integral part will be freezed and blocked.

PID has following value :
“**Error**” (error value displayed in D90) = **SP - PV**;
“**LMN_P**” (proportional part displayed in D87) = **filtered (KP * Error)**;
“**LMN_I**” ((integral part displayed in D88) = **LMN_I + (KP * Error / (T_DRW_PWM * TI)**;
“**LMN_D**”(derivative part displayed in D89)=**TD*KP*(Error - Error_Last)*T_DRW_PWM**;
“**XOUT**” (PID regulator output displayed in D91) = **LMN_P + LMN_I + LMN_D**

Whereas T_DRW_PWM = 1000 / P101 with P101 = PWM frequency and Error_Last is the error value of the previous control cycle.

N.B. In the folder “PID Controller” with the parameter "EN_PID" (E71 - Enabling Genera PID Control) is possible to disable the PID control function. If this parameter is disabled the PID control is not active.



3.3.3 Stop In Position

If the drive is working in speed control, this particular function gives the chance to stop in a specific and absolute position of the rotation revolution (stop target position). Once the stop position has been reached, it is possible to command a relative movement of ±180°. Moreover there is the chance of choosing the indexing speed and if to stop without inverting the rotation direction or not. The sensor needs to have an absolute indication of the mechanical position, so if it is an Incremental Encoder , zero TOP is necessary (obviously it is essential to run at least a one complete revolution before entering the stop-order). If Resolver feedback is used, this must be a single pole pair one.
The stop in position can optionally be referred to a mechanical turn after a reduction gear using the zero TOP on the load. The typical stop in position application is the indexing for the tool changing system.

Name	Description	Min	Max	Def	UM	Scale
EN_STOP_POS	E55 - Enabling Stop in position	Range 0 No 1 Same direction 2 Minimum track		0		1
STOP_POS_CMD	E56 - Stop in position comand selection	Range 0 Input I29 1 Speed ref		0		1
EN_STOP_POS_GBOX	E57 - Enabling Stop in position after gearbox	0	1	0		1
ZERO_TOP_SEL	E58 - Stop in position comand selection	Range 0 Sensor connector (first sensor) 1 Eighth digital input (first sensor) 2 Sensor connector (second sensor) 3 Eighth digital input (second sensor)		0		1
PRC_SPD_INDEX	E59 - Indexing speed reference value	0.00	100.00	2.0	% MOT_SPD_MAX	163.84

POS_REG_KP	P38 - Kv position loop proportional gain	0.0	100.0	4		10
STOP_POS0	E60 - Target 0 Stop in position	0.00	100.00	0	% 360 degree	163.84
STOP_POS1	E61 - Target 1 Stop in position	0.00	100.00	0	% 360 degree	163.84
STOP_POS2	E62 - Target 2 Stop in position	0.00	100.00	0	% 360 degree	163.84
STOP_POS3	E63 - Target 3 Stop in position	0.00	100.00	0	% 360 degree	163.84
ANG_MOV	E64 - Angular movement Stop in position	-50.00	50.00	0	% 360 degree	163.84
POS_WINDOW	E65 - Position Reached window	0.00	50.00	0.15	% 360 degree	163.84
TIME_WINDOW	E66 - Time on Position Reached window	0	19999	10	ms	1
PRC_SPD_MIN_AUTO	E67 - Minimum speed for automatic stop	0.00	100.00	1.0	% MOT_SPD_MAX	163.84
SPD_MIN_HYST	E68 - Minimum speed hysteresis	0.00	100.00	0.0	% MOT_SPD_MAX	163.84
GBOX_NUM	E69 - Gearbox NUM	0	16384	100		1
GBOX_DEN	E70 - Gearbox DEN	0	16384	100		1
DIS_STOP_POS	E54 - Disable stop in position when incremental position loop is enable	0	1	0		1
EN_STOP_POS_AUTOSET	E92 - Enable autoset current position as stop in position target	0	1	0		1

3.3.3.1 Stop in Position Logic Input Functions

		NAME	INPUT LOGIC FUNCTIONS
I	27	ID_POS_SEL0	Stop in position target selection (bit0)
I	28	ID_POS_SEL1	Stop in position target selection (bit1)
I	29	ID_EN_POS	Enable Stop in position function
I	30	ID_EN_POS_NOV	Enable Stop in position movement

3.3.3.2 Stop in Position Logic Output Functions

		NAME	OUTPUT LOGIC FUNCTIONS
O	33	OD_STOP_POS_ON	Stop in position target reached

3.3.3.3 Stop in Position Analog Output and Monitor

		OUTPUT ANALOG FUNCTIONS
O	68	Stop in position target [100%=180]
O	69	Stop in position actual position [100%=180]
O	70	Stop in position error [100%=180]
O	71	Stop in position o33 timer [ms]

3.3.3.4 Stop in Position Alarm

ALARM		DESCRIPTION	CORRECTIVE ACTION
A4.0	Excessive indexing speed	In equiverse indexing the indexing speed has a maximum value admitted, depending on max speed (P65) and position loop gain (P38)	Reduce indexing speed E59 or change indexing mode selecting minimum track
A4.1	Zero TOP missing	4 motor revolutions completed without reading Zero Top	Check sensor and cable.

3.3.3.5 Working Mode

With the drive working in speed control , there is the chance of enabling the function " Stop in position " in two different ways, based on **E56** : if E56 = 0 the input function I29 **"Stop in position command "** must be set to high logic level ; if P256 = 1 "Stop in position command " is taken when the speed reference goes below of the threshold value preset on **E67** (on **E68** the hysteresis on the stop activation can be set).

Note: the speed reference that is tested is the one in percent of the max speed ("sysSpeedPercReference") in case the frequency input is used, the timing signal decoding must be enabled.
Once this function has been activated the drive follows a ramp speed reference (automatically activated) to reach the indexing speed. The indexing speed is programmable in **E59** in percent of the max speed of the drive. At this point it is possible to choose how to stop with P255.

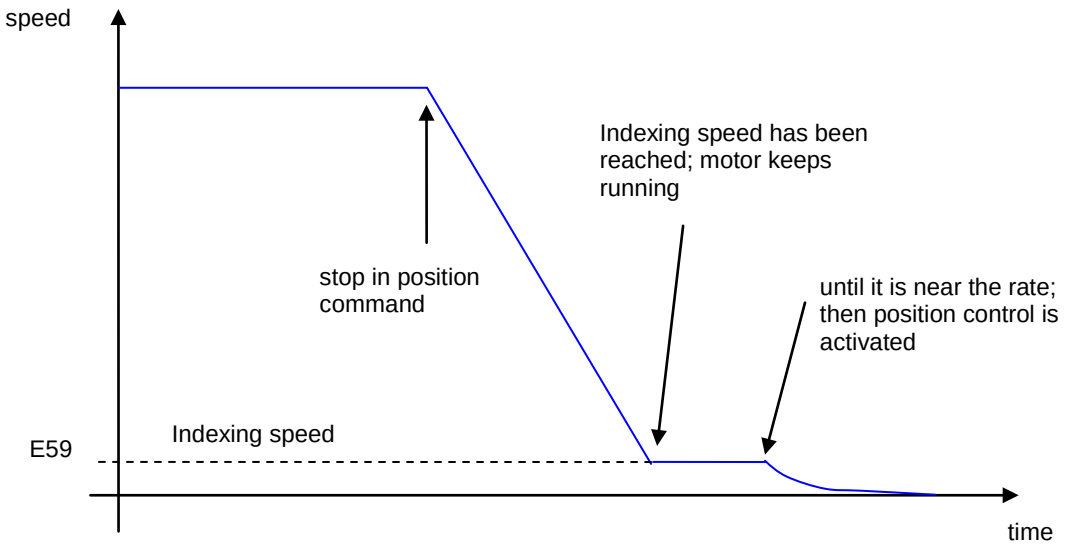
The selectable stop positions are 4, the default value is set on **E60**, the other on **E61, E62** and **E63,** in percent of the revolution, related to the absolute position.
It's possible to select the stop position using the logical function inputs **I27** and **I28**, how it's shown in the following table:

Code I27 & I28		Position selected	Description
0	0	E60	Stop target position 0
0	1	E61	Stop target position 1
1	0	E62	Stop target position 2
1	1	E63	Stop target position 3

with **E55=1** without changing the motor rotation verse after the stop in position is commanded.
With parameter "EN_STOP_POS_AUTOSET" E92=1 the actual position is stored on the stop target position selected.

3.3.3.6 Stop In Position And Position Loop

With parameter E54 "DIS_STOP_POS" is possible to disable the stop in position function when incremental position loop is enabled.


speed
Indexing speed has been reached; motor keeps running
stop in position command
until it is near the rate; then position control is activated
E59
Indexing speed
time

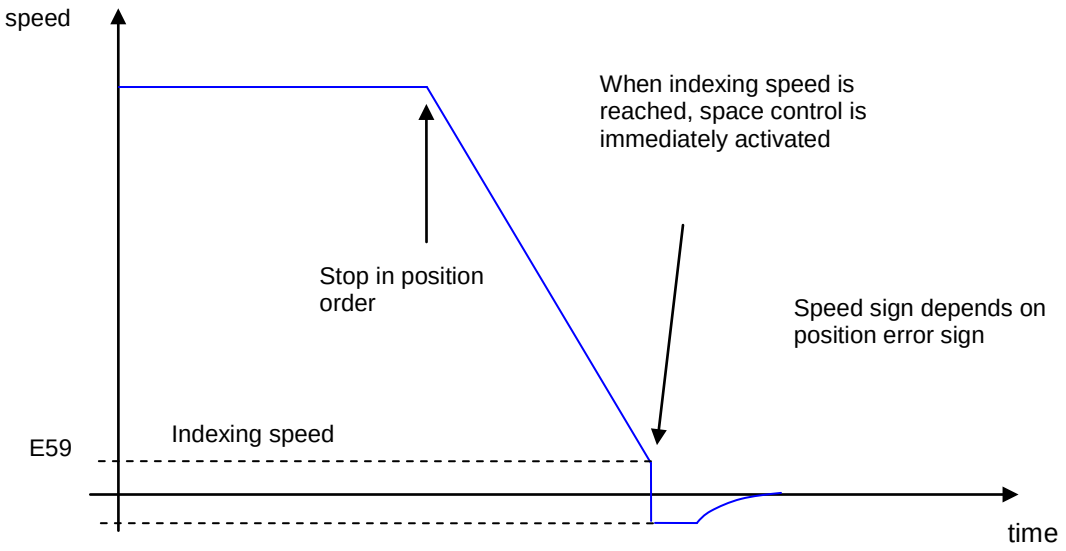
NB: in this modality, to activate position control, it is necessary that the max. position error (180°) multiplied by the position loop gain (P38) being greater than the indexing speed (E59), thus:

$$\frac{E59}{100} \leq P38 \cdot \frac{30}{P65}$$

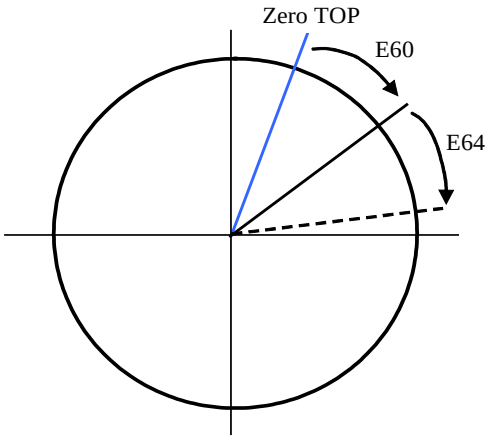
E.g : P38 = 4.0
P65 = 1500 ⇨ E59 ≤ 8 % maximum speed

If this condition isn't true, appears alarm A4.0

if **E55=2** always following the minimum track



Anyway the speed reference generated by the position control can never exceed the indexing speed (in absolute value) set on E59.
Once the drive is stopped in position, for a time programmable in **E66**, the logic output function **O33**, becomes active. It is possible to set the uncertain area of the logic output on parameter **E65**, in percent on the revolution, as max distance (+ or -) from the correct position.
At this point it is possible to command another movement by activating the input function **I30** “execute the angular movement”.
The amplitude of the movement can be set in **E64** in percent of the revolution.
In any case the motor will move on the minimum path to reach the reference position and the speed will never go over the indexing one.(**E59**).



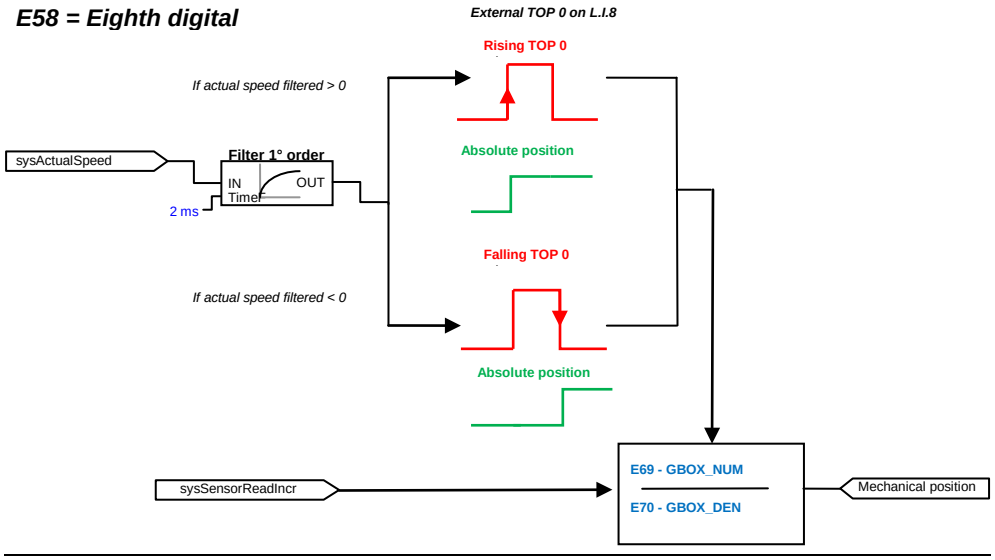
3.3.3.7 Stop in Position Downstream Reduction Gear

This function is enabled setting **E57=1** and it's very important to set correctly the reduction ratio into parameters **E69** and **E70** corresponding to numerator and denominator (with E70 ≥ E69).
When this particular control is enabled, the stop position and angular movement (**E60** e **E64**) are referred to the absolute position downstream reduction gear.
There are two different working mode for the zero TOP management downstream reduction gear, selectable with **E58** connection:

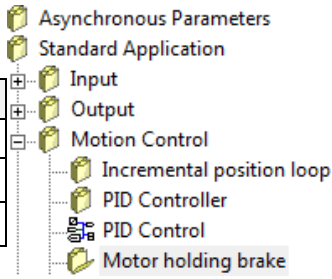
with **E58=0** and only with Incremental Encoder (with or without Hall sensors) the zero TOP have to be connected to **PC1** and **/PC1** channels motor sensor connector.

with **E58=1** the zero TOP have to be connected to the eighth logic input on **M3** connector. It's necessary to de-configure the logic function related to eighth logic input **C08=-1**.
The zero position will be stored on rising edge (0 → 1), if is negative the zero position will be stored on falling edge (1 → 0). The situation is explained in the following scheme:

In both cases, the zero pulse width have to be at least 26us.



3.3.4 Motor Holding Brake

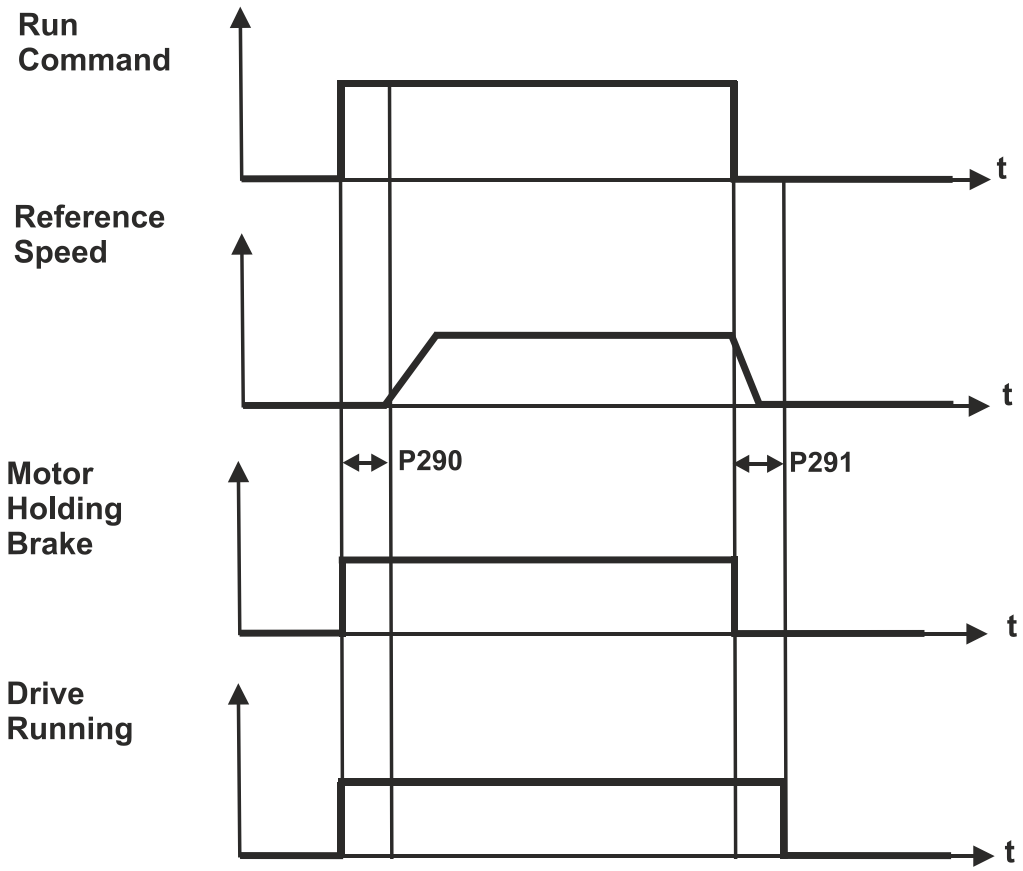


Name	Description	Min	Max	Def	UM	Scale
EN_HLD_BRAKE	E89 - Enable Motor Holding Brake	0	1	0		1
HLD_BRAKE_DIS_DLY	E90 - Motor holding brake disable delay at start	0	19999	0	ms	1
HLD_BRAKE_EN_DLY	E91 - Motor holding brake enable delay at stop	0	19999	0	ms	1

3.3.4.1 Motor Holding Brake Output Functions

		NAME	OUTPUT LOGIC FUNCTIONS
O	32	OD_MOTOR_HOLDING_BRAKE	Motor holding brake

With parameter **E89=1** it's possible enable the command to open and close an external mechanical brake. The parameter **E90** defines the delay time at start, while the parameter **E91** the delay time at stop:



The figure shows the situation when the brake is disabled (on the left) and when is enabled (on the rigth). At time **t0** Run Command is given an internal timer is activated, at the same the digital output **O32** goes to the high level.
From **t0** to **t0 + E90** every Speed Reference is annulled, the drive is in the RUN state (motor in torque) and the Holding Brake can be disabled.
When the internal timer reaches the overflow value (E90) the speed reference is enabled.

At time t0 Run Command is disabled and O32 goes to low level too. A second timer is activate and speed reference is disabled. From **t1** to **t1 + E91** the drive stops with his deceleration ramp but remain in run state. The holding brake can be enabled. When the second timer reaches the overflow value (E91) the Drive Running State is disabled.

4 CATALOG APPLICATIONS

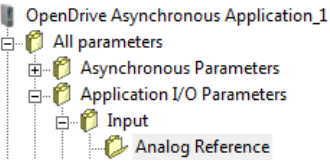
The functions seen in previous chapter refer to the standard application, in the application “catalog” (downloadable from Brushless or Asynchrous “application” project) these functions can not be present, so please refer to the application manual itself for more details.
Some functions, however depend on the core and are otherwise present both in the standard application and the catalog application.
Following be repeated all the functions seen previously, noting wich ones are always present.

Parameters:
P00-P199 are common to all applications (standard and catalog),
E00-E99 instead depend on the type of application.

Connections:
C00-C99 are common to all applications (standard and catalog),

Internal values:
d00-d63 are common to all applications (standard and catalog),
d64-d99 instead depend on the type of application.

4.1 INPUTS

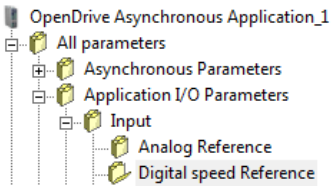


4.1.1 Analog Reference

The scaling of the analog reference can always be done (P01 and P02 for AI1, the same is true for the characteristic parameters of AI2, AI3 and AI16), as well as the input value can always be viewed (d42 by AI1, d43 by AI2, d44 by AI3). Also the enable current analog reference is always present.
The choise (optional) of the meaning of each input, as well as the enable reference ,instead, dependes on the type of application.
The parameters in the following table are also present in the catalog application.

Name	Description	Min	Max	Default	UM	Scale
EN_AI1_4_20mA	C95 - Enable AI1 4-20mA	0	1	0		1
KP_AI1	P01 - Corrective factor for analog reference 1 (AUX1)	-400.0	400.0	100	%	10
OFFSET_AI1	P02 - Corrective offset for analog reference 1 (AUX1)	-100.0	100.0	0	%	163.84
AI1	D42 - Analog Input AI1	-100	100	0	%	163.84
EN_AI2_4_20mA	C96 - Enable AI2 4-20mA	0	1	0		1
KP_AI2	P03 - Corrective factor for analog reference 2 (AUX2)	-400.0	400.0	100	%	10
OFFSET_AI2	P04 - Corrective offset for analog reference 2 (AUX2)	-100.0	100.0	0	%	163.84
AI2	D43 - Analog Input AI2	-100	100	0	%	163.84
EN_AI3_4_20mA	C97 - Enable AI3 4-20mA	0	1	0		1
KP_AI3	P05 - Corrective factor for analog reference 3 (AUX3)	-400.0	400.0	100	%	10
OFFSET_AI3	P06 - Corrective offset for analog reference 3 (AUX3)	-100.0	100.0	0	%	163.84
AI3	D44 - Analog Input AI3	-100	100	0	%	163.84
PRC_APP_T_REF	D10 - Torque reference value (application generated)	-100	100	0	% MOT_T_NOM	40.96
AI16	16 bit analog input (optional)	-100.00	100.00	0.00	%	163.84
PRC_APP_SPD_REF	D33 - Speed reference (application generated)	-100	100	0	% MOT_SPD_MAX	163.84
KP_AI16	P13 - Corrective factor for 16 bit analog reference (AUX16)	-400.0	400.0	100.0	%	10
OFFSET_AI16	P14 - Corrective offset for 16 bit analog reference (AUX16)	-100.0	100.0	0	%	163.84

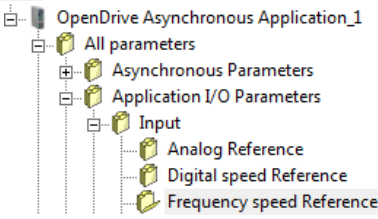
4.1.2 Digital Speed Reference



Digital potentiometer speed references and digital speed reference normally are never present in the catalog applications, some applications may be inside some similar enabling digital speed reference function.

Name	Description	Min	Max	Default	UM	Scale
PRC_APP_SPD_REF	D33 - Speed reference (application generated)	-100	100	0	% MOT_SPD_MAX	163.84

4.1.3 Frequency Speed Reference



The choice of the type of speed in pulses is always present:

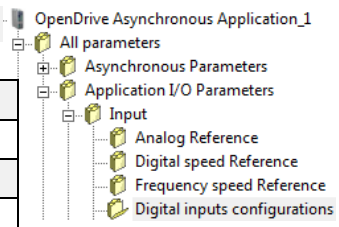
C09	Description	Mode of working
0	*Analogic*	Analog reference ±10V (optional)
1	Digital encoder	4 track frequency reference (default)
2	Digital f/s	Frequency reference (freq. and up/down) counting all edges
3	Digital f/s 1 edge	Frequency reference (freq. and up/down) counting one edge

Also some parameters and internal value are always present:

Name	Description	Min	Max	Default	UM	Scale
FRQ_IN_SEL	C09 - Frequency input setting	Range 0 Analogic 1 Digital Encoder 2 Digital f/s 3 Digital f/s 1 edge		1		1
REF_FRQ_IN	D12 - Frequency in input			0	KHz	16
PRC_APP_FRQ_SPD_REF	D14 - Frequency speed reference value (application generated)	-100	100	0	% MOT_SPD_MAX	163.84
MAXV_VF	P88 - High precision analog speed reference value: Voltage matches max. speed	2500	10000	10000	mVolt	1
OFFSET_VF	P10 - Offset for high precision analog reference value	-19999	19999	0	1/100 mV	1
KP_NEG_VF	P159 - High precision analog speed reference value:VCO setting for negative voltage reference values	-16383	16383	4096		1
KP_POS_VF	P150 - High precision analog speed reference value:VCO setting for positive voltage reference values	-16383	16383	4096		1

The eventual enable frequency input, of its meaning and possible numerator/denominator scaling, however, depends on the type of the application.

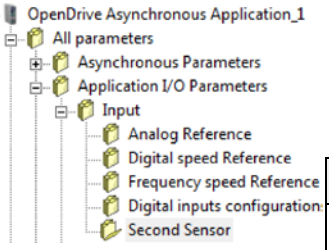
4.1.4 Digital Inputs Configurations



Name	Description	Min	Max	Default	UM	Scale
TF_LI6-7-8	P15 - I06,07,08 logical inputs digital filter	0.0	20.0	2.2	ms	10
EN_NOT_LI	C79 - Enable negative logic for digital inputs	0	255	0		1
LI1_SEL	C01 - Meaning of logic input 1	-1	31			1
LI2_SEL	C02 - Meaning of logic input 2	-1	31			1
LI3_SEL	C03 - Meaning of logic input 3	-1	31			1
LI4_SEL	C04 - Meaning of logic input 4	-1	31			1
LI5_SEL	C05 - Meaning of logic input 5	-1	31			1
LI6_SEL	C06 - Meaning of logic input 6	-1	31			1
LI7_SEL	C07 - Meaning of logic input 7	-1	31			1
LI8_SEL	C08 - Meaning of logic input 8	-1	31			1

The logic inputs always present are:
I00-Run command,
I02-External enable,
I08-Reset alarms

Others depend on the application. They can be configured (and optionally deniable with C79) the same way as the present inputs for standard application.

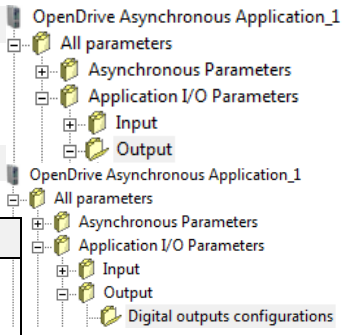


4.1.5 Second Sensor

The management parameters of the second sensor are always present, while the enable depends on the application.

Name	Description	Min	Max	Default	UM	Scale
SENSOR2_SEL	C17 - Sensor2 selection	Range 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14	 Encoder Resolver Resolver RDC Sin/Cos incr Endat 1317 Endat 1329 Endat 125	0		1
RES2_POLE	P16 - Number of absolute sensor2 poles	1	160	2		1
ENC2_PPR	P17 - Number of encoder2 pulses/revolution	0	60000	1024	pulses/rev	1
EN_TIME_DEC_ENC2	C18 - Enable incremental encoder2 time decode	0	1	0		1
EN_INV_POS2_DIR	C20 - Invert sensor2 positive cyclic versus	0	1	0		1
EN_SENSOR2_TUNE	U00 - Enable sensor2 autotunig	0	1	0		1
RES2_TRACK_LOOP_BW	P48 - Tracking loop bandwidth direct decoding of resolver2	100	10000	1800	rad/s	1
RES2_TRACK_LOOP_DAMP	P49 - Damp factor Traking loop resolver2	0.00	5.00	0.71		100
KP_SENS2	P07 - Second sensor amplitude compensation	0.0	200.0	100	%	163.84
OFFSET_SIN_SENS2	P08 - Second sensor sine offset	-16383	16383	0		1
OFFSET_COS_SENS2	P09 - Second sensor cosine offset	-16383	16383	0		1
HW_SENSOR2	D62 - Sensor2 presence			0		1
SENS2_SPD	D51 - Second sensor rotation speed			0	rpm	1
SENS2_TURN_POS	D52 - Second sensor Absolute mechanical position (on current revolution)			0	16384	1
SENS2_N_TURN	D53 - Second sensor Number of revolutions			0	16384	1
SENS2_FRQ_IN	D54 - Second sensor Frequency input			0	KHz	16
SENS2_ZERO_TOP	D56 - Sensor2 Zero Top			0	pulses	1
RES2_DDC_BW	C25 - Second resolver DDC bandwidth	0	1	0	Hz	1
EN_SLOT_SWAP	C19 - Enable sensor slot swap	Range 0 1	 No Yes	0		1
SENS2_RES	Second sensor resolution			0	bit	1
SENS2_POS	Second sensor actual position			0	sensor pulses	1

4.2 OUTPUT

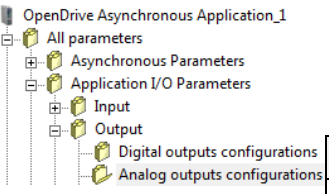


4.2.1 Digital Outputs Configurations

Name	Description	Min	Max	Default	UM	Scale
I_RELAY_SEL	C55 - Current relay output	Range 0 1 2	 I/I NOM MOT T/T NOM POT P/P NOM POT	0		1
I_RELAY_THR	P26 - Current/power relay cut-in threshold	0.2	150.0	100	%	40.96
TF_I_RELAY	P27 - Filter time constant for current/power relay	0.1	10.0	1	s	10
DO_SPD_REACH_THR	P47 - Speed threshold for logic output o.16	0.0	100.0	0	%MOT_SPD_MAX	163.84
DO_SPD_MIN_THR	P50 - Minimum speed for relay	0.0	100.0	2.0	%MOT_SPD_MAX	163.84
HYST_DO_SPD	P59 - Minimum anda maximum speed reached output hysteresis	0.0	100.0	1.0	%MOT_SPD_MAX	163.84
LO1_SEL	C10 - Meaning of logic output 1	-64	63			1
LO2_SEL	C11 - Meaning of logic output 2	-64	63			1
LO3_SEL	C12 - Meaning of logic output 3	-64	63			1
LO4_SEL	C13 - Meaning of logic output 4	-64	63			1

The commons logical outputs are those in the range o00 – o26. The other depends by application.

		NAME	OUTPUT LOGIC FUNCTIONS	DEFAULT OUTPUT
O	00	OD_DRV_READY	Drive ready	L.O.2
O	01	OD_ALR_KT_MOT	Moto thermal alarm	
O	02	OD_SPD_OVR_MIN	Speed greater than minimum	L.O.4
O	03	OD_DRV_RUN	Drive running	L.O.1
O	04	OD_RUN_CW	CW / CCW	
O	05	OD_K_I_TRQ	Current/torque relay	
O	06	OD_END_RAMP	End of ramp	L.O.3
O	07	OD_LIM_I	Drive at current limit	
O	08	OD_LIM_TRQ	Drive at torque limit	
O	09	OD_ERR_INS	Tracking incremental error > threshold (P37 ane P39)	
O	10	OD_PREC_OK	Power soft-start active	
O	11	OD_BRK	Braking active	
O	12	OD_POW_OFF	No mains power	
O	13	OD_BUS_RIG	Bus regeneration enable (Support 1)	
O	14	OD_IT_OVR	Motor overheating (exceeds threshold P96)	
O	15	OD_KT_DRV	Radiator overheating (higher than P120 threshold)	
O	16	OD_SPD_OK	Speed reached (absolute value higher than P47)	
O	17	OD_SPD_REF_RCH	Safe torque off active	
O	19	OD_POS_INI_POL	Regulation card supplied and DSP not in reset state	
O	20	OD_SNS1_ABS	SENS1 Absolute position available	
O	21	OD_DRV_OK	Drive ready and Power Soft start active	
O	22	OD_LL_ACTV	LogicLab application active	
O	23	OD_STO_OK	STO: not dangerous failure	
O	24	OD_TRQ_CTRL	Torque control	
O	25	OD_VBUS_OK	DC bus voltage exceeds threshold (P79)	
O	26	OD_BRK_FLT	Braking circuit fault (MiniOPDE only)	



4.2.2 Analog Outputs Configurations

The configuration parameters are the same:

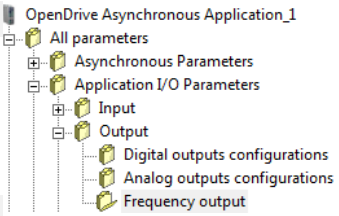
Name	Description	Min	Max	Default	UM	Scale
AO1_SEL	C15 - Meaning of programmable analog output 1	-99	100			1
AO2_SEL	C16 - Meaning of programmable analog output 2	-99	100			1
PRC_AO1_10V	P57 - % value of 10V for analog output A	100.0	400.0	200	%	10
PRC_AO2_10V	P58 - % value of 10V for analog output B	100.0	400.0	200	%	10
OFFSET_AO1	P110 - Offset A/D 1	-100.0	100.0	0	%	327.67
OFFSET_AO2	P111 - Offset A/D 2	-100.0	100.0	0	%	327.67

While the analog outputs selectable are common only in the range o00 – o66, the other depends by application:

		OUTPUT ANALOG FUNCTIONS	DEFAULT OUTPUT
O	00	Actual mechanical position read by sensor[100%=180]	
O	01	Actual electrical position read by sensor(delta m) [100%=180]	
O	02	Reference speed value before ramps [% n mAX]	
O	03	Reference speed value after ramps [% n MAX]	
O	04	Rotation speed filtered [% n MAX]	A.0.2
O	05	Torque request [% C NOM MOT]	
O	06	Internal value: status (MONITOR only)	
O	07	Request to current loop for torque current [% I NOM AZ]	
O	08	Request to current loop for flux current [% I NOM AZ]	
O	09	Max voltage available [% VNOM MOT]	
O	10	Internal value: alarms (MONITOR only)	
O	11	Current module [% I NOM AZ]	A.0.1
O	12	Motor sensor Zero Top [100%=180]	
O	13	U phase current reading [% I MAX AZ]	
O	14	Internal value: inputs (MONITOR only)	
O	15	Torque component of current reading [% I NOM AZ]	
O	16	Magnetizing component of current reading [% I NOM AZ]	
O	17	U phase voltage duty-cycle	
O	18	Stator voltage reference value module [% VNOM MOT]	
O	19	Modulation index [0<->1]	
O	20	Request Q axis voltage (Vq_rif) [% VNOM]	
O	21	Delivered power [% PNOM]	
O	22	Request D axis voltage (Vd_rif) [% VNOM]	
O	23	Torque produced [% C NOM MOT]	
O	24	DC bus voltage [100%=900V]	
O	25	Radiator temperature	
O	26	Motor temperature	
O	27	Rotor flux [% NOM]	
O	28	Motor thermal current [% alarm threshold A6]	
O	29	Current limit [% I MAX AZ]	
O	30	CW maximum torque [% C NOM MOT]	
O	31	CCW maximum torque [% C NOM MOT]	
O	32	Internal value: outputs (MONITOR only)	
O	33	Internal value: inputs_hw (MONITOR only)	
O	34	V phase current reading [% I MAX AZ]	
O	35	W phase current reading [% I MAX AZ]	

O	36	Actual electrical position (alfa_fi) [100%=180]	
O	37	Analog input A.I.1	
O	38	Analog input A.I.2	
O	39	Analog input A.I.3	
O	40	Positive speed reference limit [% n MAX]	
O	41	Application speed reference value ("sysSpeedPercReference") [% n MAX]	
O	42	Application torque reference value ("sysTorqueReference") [% C NOM MOT]	
O	43	Application positive torque limit ("sysMaxTorque") [% C NOM MOT]	
O	44	Frequency speed reference value from application ("sysSpeedRefPulses") [Pulses per TPWM]	
O	45	Overlapped space loop reference value from application ("sysPosRefPulses")[Pulses per TPWM]	
O	46	Amplitude to the square of sine and cosine feedback signals [1=100%]	
O	47	Sen_theta (Direct resolver and Sin/Cos Encoder) [Max amplitude = 200%]	
O	48	Cos_ theta (Direct resolver and Sin/Cos Encoder) [Max amplitude = 200%]	
O	49	Rotation speed not filtered [% n MAX]	
O	50	Delta pulses read in PWM period in frequency input [Pulses per PWM]	
O	51	Overlapped space loop memory lsw [Electrical pulses (x P67)	
O	52	Overlapped space loop memory msw [Electrical turns (x P67)]	
O	53	Incremental SIN theta Sin/Cos Encoder	
O	54	Incremental COS theta Sin/Cos Encoder	
O	55	Ended initial reset	
O	56	PTM motor thermal probe	
O	57	PTR radiator thermal probe	
O	58	Pulses read by sensor	
O	59	SENS2 Rotation speed not filtered	
O	60	SENS2 Actual position	
O	61	SENS2 Sin_theta	
O	62	SENS2 Cos_theta	
O	63	SYNC delay measured	
O	64	Application negative torque limit (“sysMaxNegative Torque”) [%C NOM MOT]	
O	65	Energy dissipated on breaking resistence [joule]	
O	66	IGBT junction temperature [%100°]	

4.2.3 Frequency Output

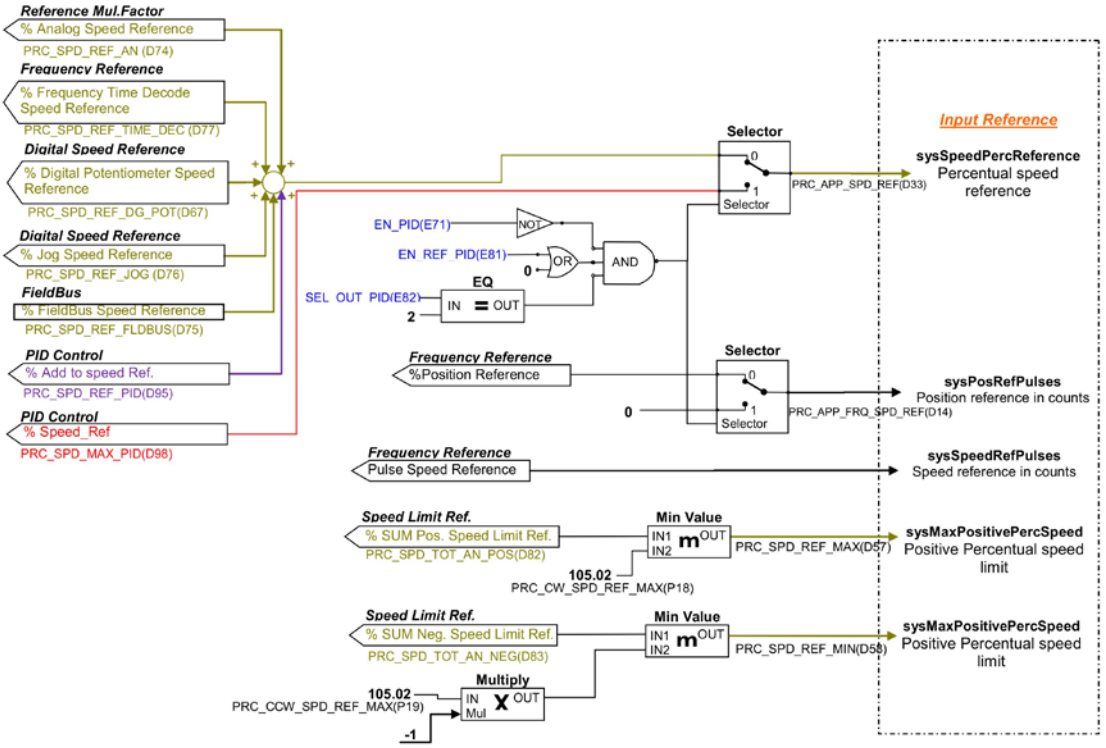


The output frequency is managed directly from the core, so the catalog application have the same function of the standard application. You can refer to paragraph 3.2.3 pag. for the catalog application.

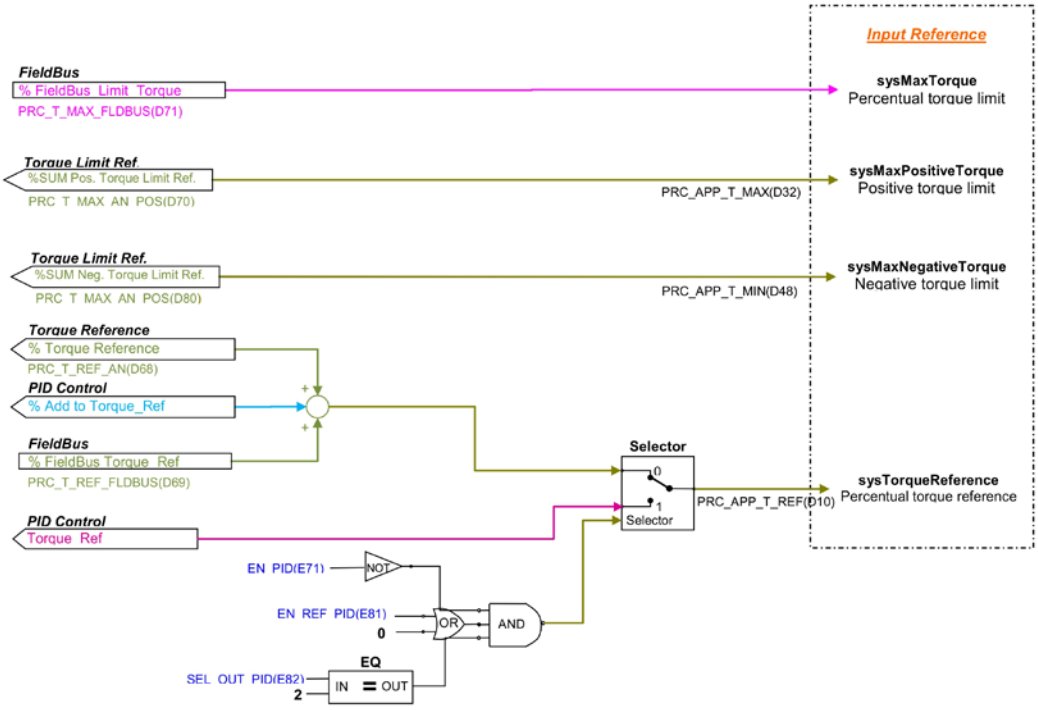
4.3 MOTION CONTROL

Incremental position loop, PID controller, stop in position and motor holding brake are features of the standard application, so they are not present in the catalog application.

Speed Command Reference

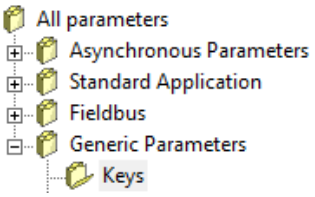


Torque Command Reference



5 GENERIC PARAMETERS

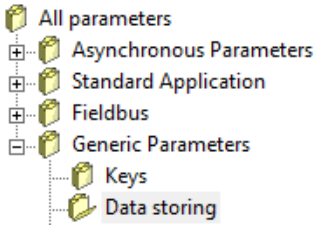
5.1 KEYS



Name	Description	Min	Max	Default	UM	Scale
RES_PAR_KEY	P60 - Access key to reserved parameters	0	65535	0		1
BLU_PAR_KEY	P99 - Access key to BLU parameters	0	19999	0		1
RES_PAR_KEY_VAL	P100 - Value of access key to reserved parameters	0	19999	0		1

P60 and P99 are two parameter that if correctly set allow some reserved parameter (only at a standstill). In particular:
if the value of P60 is the same of the key is possible to modify the reserved parameters.
If the value of P99 is the same of the key is possible to modify the BLU parameters.

5.2 DATA STORING

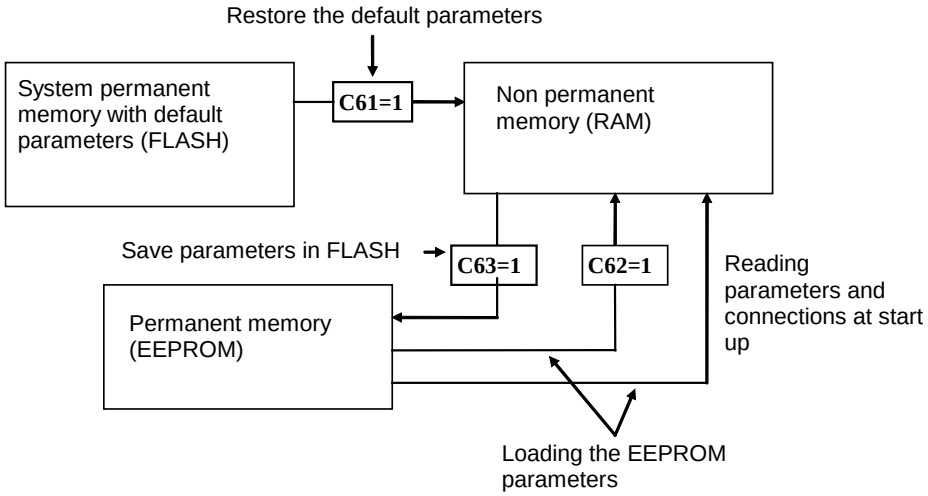


Name	Description	Min	Max	Default	UM	Scale
DEF_PAR_RD	C61 - Read default parameters	0	1	0		1
EEPROM_PAR_RD	C62 - Read parameters from EEPROM	Range: 0 = No; 1 = Yes; 2 = Restore factory par		0		1
EEPROM_PAR_WR	C63 - Save parameters in EEPROM	0	1	0		1
PAR_ACT_BANK	C60 - Parameter bank active	0	1	0		1
ALL_COUNT_RESET	C44 - Reset alarm counters	0	2	0		1
OFFSET_AI1_BLU	Factory corrective offset for analog reference 1 (AI1)	-100.0	100.0	0	%	163.84
OFFSET_AI2_BLU	Factory corrective offset for analog reference 2 (AI2)	-100.0	100.0	0	%	163.84
OFFSET_AI3_BLU	Factory corrective offset for analog reference 3 (AI3)	-100.0	100.0	0	%	163.84
KP_DCBUS_BLU	Factory corrective factor for Bus voltage	0.0	200.0	100	%	10
KP_MOT_THERM_PRB_BLU	Factory multiplication factor for motor PTC/NTC/KTY84 analog reference value	0.00	200.00	100		163.84
KP_DRV_THERM_PRB_BLU	Factory multiplication factor for radiator PTC/NTC analog reference value	0.00	200.00	100		163.84

5.2.1 Storage And Recall Of The Working Parameters

The drive has three types of memory:
The non permanent work memory (RAM), where the parameters become used for operation and modified parameters become stored; such parameters become lost due to the lack of feeding regulation.
The permanent work memory (EEPROM), where the actual working parameters become stored to be used in sequence (C63=1, Save Parameters on EEPROM).
The permanent system memory where the default parameters are contained.
When switched on, the drive transfers the permanent memory parameters on to the working memory in order to work. If the modifications carry out on the parameters, they become stored in the work memory and therefore become lost in the break of feeding rather than being saved in the permanent memory.
If after the work memory modifications wants to return to the previous security, it is acceptable to load on such a memory, a permanent memory parameter (Load EEPROM Parameter C62=1).
If for some reason the parameters in EEPROM change, it is necessary to resume the default parameters (C61=1 Load Default Parameters), to make the appropriate corrections and then save them in the permanent working parameter (C63=1).

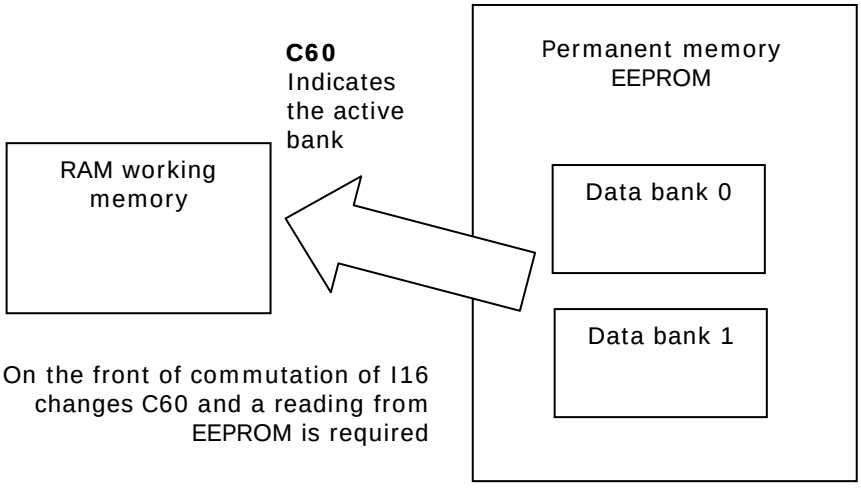
It is possible to save the data in the permanent memory also at drive switched on/RUN, while the loading may only be affected aside with drive switched off/STOP, after having opened the key to reserved parameters.
Starting from 12.10 revision, during permanent memory writing (C63=1) the data are immediately read after its writing. If any inconsistency is detect, alarm A1.2 appears.
In this case resets the alarm and try again to store the data.



Because the default parameters are standard to be different than those that are personalized, it is correct that after the installation of each drive, there is an accurate copy of permanent memory parameters to be in the position to reproduce them on an eventual drive exchange.

5.2.1.1 Active Bank Parameters

This function allows to switch over the internal sets of parameters and connections between two distinct memory banks (drive must be switched off, no RUN).
To activate this function, it is necessary to use the logic input I16, configuring it on a logic input on both banks. The connection C60 indicates the actual data bank in the permanent memory: C60=0 bank 0; C60=1 bank 1. The commutation of the functions logic stage I16 brings an automatic variation of data of C60 and a successive automatic reading of data from the permanent memory


C60
Indicates the active bank
Permanent memory EEPROM
RAM working memory
Data bank 0
Data bank 1
On the front of commutation of I16 changes C60 and a reading from EEPROM is required

For initial configuration of the input function I16, follow these steps:

1. Prepare in RAM, the data in bank 0, configuring input function I16 and holding it to a low logic level (make sure C60=0).
2. Save to the permanent memory with C63=1.
3. Always keep I16=L, prepare in RAM the data from bank 1, configuring the same input to the function I16.
4. Set C60=1 and save the data in the permanent memory with C63=1.
5. At this point, changing the state of logic input corresponding to function I16, the bank's commutation will have automatic reading

5.2.1.2 Restore Factory Parameters

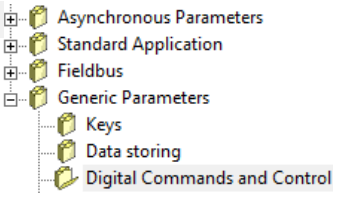
Starting from 12.10 revision when the drive goes out from BLU its data are stored into a permanent memory like factory parameters and firmware revision also.
Subsequently it is possible to restore this data setting C62=2.
When this function is enabled the behavior depends on the actual firmware revision:

- If the current firmware revision is exactly the same of when the drive left BLU ("FACTORY_FW_REV" available on Brushelss Parameters folder of OPDExplorer) all core parameters and connections are reloaded, independently of keys status.

- If the current firmware revision is different the default core parameters and connections are loaded except some particular parameters (P94, P100÷P120, P154÷P157, P167, P198, P199, C22, C24, C45 and C98).

In every case all application parameters came back to their default values.
Profibus, Anybus, SinCos sensor table, Monitor configuration data came back to their default values.
If the factory data are invalid, alarm A1.1 appears and all default parameters are loaded.

5.3 DIGITAL COMMANDS AND CONTROL



Name	Description	Min	Max	Default	UM	Scale
SW_RUN_CMD	C21 - Run software enable	0	1	1		1
EN_STOP_MIN_SPD	C28 - Stop with minimum speed	0	1	0		1
DRV_SW_EN	C29 - Drive software enable	0	1	1		1
ALL_RESET	C30 - Reset alarms	0	1	0		1
EN_STO_ONLY_SIG	C73 - Enable Safety STOP only like signaling	0	1	0		1
EN_BOOT	C98 - Enable boot mode	0	1	0		1
SPD_ISR	Speed routine duration			0	us	64
I_ISR	Current routine duration			0	us	64
APP_ISR	Application fast task duration			0	us	64
APP_AVBLE_ISR	Application fast task available time			0	us	64
DRV_F_PWM_MAX	Max PWM frequency available			0	Hz	1
APP_CYCLIC_ISR	Application cyclic task duration			0	us	64
DISPLAY_SEL	C14 - Display selection	0	127	0		1
DISPLAY_WAIT	P112 - Display time to come back to idle state	3	20	10	s	1
WORK_HOURS	D49 - Work hours			0	hours	1
SERIAL_NUMBER	D59 - Drive serial number			0		1
PWM_COUNTER	ISR counter			0.0		1
ALL_ENAB	P163 - Alarm enable	0	65535	65535	Hex	1
SW_RESET_CNT	Software reset occours			0		1

The "DRV_F_PWM_MAX" is the maximum PWM frequency allowed with the functions enabled.

5.3.1 Drive Ready

The Drive Ready condition (**o.L.0=H**) is given by alarms are not active and at the same time both the software and hardware enables:
* The software enable, given by state of the connection **C29**, (C29=1 of default).
* The external enable (the function of the input is assigned to the default input L.I.2).

If an enable is missing or an alarm is active, the ready drive signal goes into an non-active state o.L.0=L and this state remains until the causes that brought about the alarm conditions are removed and the alarms are reset. An alarm reset can be achieved by activating the function "Alarm reset" that, by default, is assigned to input L.1 (or setting C30=1).
Keep in mind that the "Alarm reset" is achieved by the active front of the signal, not on the active level.

5.3.2 Drive Switch On / Run

When the drive is “Ready to switch on / RUN” o.L.0=H, motor may start running “Drive switch on/run” o.L.3=H, by activating both the hardware and software switch on enables:
* Function “Logic switch on/RUN input” (default input 4 assigned) RUN=H.
* Software switch on/RUN C21 (C21=1) is active by default.

Switch on/RUN disable and enable (from STOP offline, to RUN online) is given by the logic of the following table:

Drive ready o.L.0	Switch on / RUN	C21	ON-LINE
L	X	X	L
H	L	X	L
H	X	0	L
H	H	1	H

It is mentioned that the input function “Switch on/RUN input” can be given also via serial line or field-bus. See for details the Standard Application Manual.

5.3.3 Drive Switch Off / Stop

By default, the drive switch off instantaneously as soon as one of the switch on functions is disabled (immediate shutdown); that may also cause an almost immediate rotation shutdown, if the motor is loaded and the inertia is low, while coasting if the motor is without load and mechanical inertia is high.
Using the connection C28, it is possible to choose to switch off the drive only with motor at minimum speed. With C28=1, 0=immediate switch off by default, when SWITCH ON/RUN function is disable, the speed reference is brought to zero, thus the motor starts to slowdown following the ramp (the drive is still switched on). The system is switched off /STOP (offline) only once the motor absolute speed goes below the threshold set in P50 (2.0% default), that is when the motor is almost motionless (shutdown for minimum speed).
Calibrating P50 may coincide the drive block with the motionless motor. The state of speed above the minimum is signaled from the logical output function **o.L.2,** moreover the output function **o.L.16** is available, that signals the drive speed (absolute value) is above the threshold speed level P47. In every way, whichever is the chosen type of shutdown, there is an immediate drive block in presence of any alarm condition, oL.0 = L.

5.3.4 Safety Stop

The OPEN drive converters have the possibility to give the separated IGBT supply. This supply voltage can be see like safety STOP input and there are two different managements for this input, selectable with **C73** connection:

For OPEN DRIVE versions with Safe Torque Off safety function (STO) according to EN 61800-5-2 and EN 13849-1 see STO installation manual

5.3.4.1 Machine Safety (C73=0)

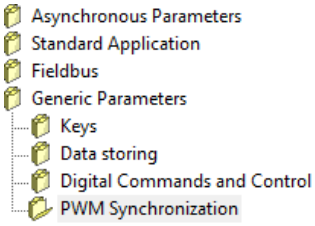
Setting **C73=0** (default) the Safety STOP is compatible with EN945-1 specification against accidental starts. When this input is at low logical level the IGBT power bridge isn’t supplied and the motor couldn’t run more than 180°/motor poles couple for brushless motor (for asynchronous motors the movement is zero), also if there is a brake in the power bridge.
The converter signals this state with the alarm **A13.1**, the output **o17 “Power electronic not supplied”** goes at high level, the output o0 “Drive ready” goes at low level and the Power Soft start command is taken off.
To recover the normal converter state, follow this steps:
Give +24V to the IGBT driver supply input (Safety STOP). At this point the converter goes at low level the output o17 “Power electronic not supplied”.
Reset the converter alarms for eliminate the alarm A13.The normal converter state is recovered.
After P94 (STO_WAIT) ms the converter is able to start the Soft start sequence.

5.3.4.2 Power Part Enable Input (C73=1)

Setting **C73=1** the Safety STOP is like a Power part enable input. Like in the preceding case,
when this input is at low logical level the IGBT power bridge isn't supplied and the motor couldn't run more than 180°/motor poles couple for brushless motor (for asynchronous motors the movement is zero), also if there is a brake in the power bridge.
The converter signals this state with the output **o17 "Power electronic not supplied"** that goes at high level, the Power Soft start command is taken off, but unlike before no alarms goes at active state.
To recover the normal converter state, follow this steps:
Give +24V to the IGBT driver supply input (Safety STOP). At this point the converter goes at low level the output o17 "Power electronic not supplied".
After P94 (STO_WAIT) ms the converter is able to start the Soft start sequence.

In this case it isn't necessary to reset the alarms after take back at high level the Safety STOP input, it will be sufficient to wait P94 (STO_WAIT) ms + soft start time, after that the converter could be goes on run.

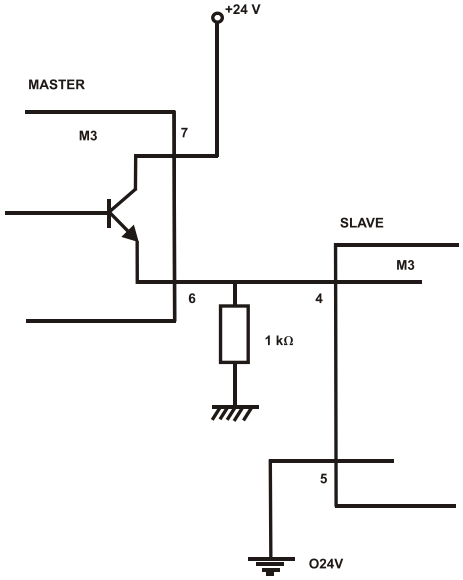
5.4 PWM SYNCHRONIZATION (STANDARD APPLICATION)



Name	Description	Min	Max	Default	UM	Scale
EN_PWM_SYNC	E87 - Enable PWM synchronization	0	2	0		1
PWM_SYNC_PHASE	E88 - PWM synchronization phase	-175.0	175.0	0	degr.	10
SYNC_REG_KP	P11 - CanOpen SYNC loop regulator Proportional gain	0	200	5		1
SYNC_REG_TA	P12 - CanOpen SYNC loop regulator lead time constant	0	20000	400		1
PWM_SYNC_OFFSET	PWM offset for SYNC delay control			0	pulses	1
PWM_SYNC_DELAY	D81 - PWM SYNC delay	-400	400	0	us	16

With this function it's possible to synchronize two or more OPDE at PWM level.
Parameter E87 is used to select the drive function:

1 Master= Every PWM period the third digital output (O3) is configured like PWM syncrhronization output.
2 Slave= Eigth physical input (I08) is used to synchronize the drive.



In the slave there is a tracking loop with gain Kp (P11) e Ta (P12). It's possible to set also the phase between master and slave with parameter E88.

Note1: Master and slave have to be set with the same PWM frequency (P101)

Note2: If the PWM frequency is great than 5kHz is necessary to use a pull-down 1kΩ resistance 1W.

6 ALARMS

6.1 MAINTENANCE AND CONTROLS

The drive has a range of functions that cut in if there is a fault in order to prevent damage to both the drive and the motor. If a protection switch cuts in, the drive output is blocked and the motor coasts.
If one or more of the protection switches (alarms) cut in, they are signalled on the displays, which start to flash and to show a cycle of all the alarms triggered (the 7-segment display shows the alarms that have been set off in hexadecimal).
Should the drive malfunction or an alarm be triggered, check the possible causes and act accordingly.

If the causes cannot be traced or if parts are found to be faulty, contact BLU and provide a detailed description of the problem and its circumstances.
The alarm indication are divide in 16 categories (A0÷A15) and for each alarm can be present code to identify better the alarm (AXX.YY)

6.1.1 Malfunctions Without An Alarm: Troubleshooting

MALFUNCTION	POSSIBLE CAUSES	CORRECTIVE ACTION
Motor does not run	RUN command not given	Check operating status of input I00
	Terminals L1, L21 and L3 are not wired properly or the power voltage is disabled	Ensure wiring is correct and check mains and motor connection Check any contactors upstream and downstream of drive are closed
Motor does not turn	Terminals U,V and W are not wired properly	
	An alarm has been triggered	See following paragraph
	Parameters programmed incorrectly	Check parameter values via the programming unit and correct any errors
Motor direction inverted	Wrong Positive direction	Invert positive speed rotation setting C76=1.
	Speed reference value inverted	Invert reference value
Motor revolutions cannot be regulated	No reference signal	Check wiring and apply reference signal if not present
	Excessive load	Reduce motor load
Irregular motor acceleration and braking	Acceleration – deceleration time/times is/are too low	Check parameters and change if necessary
	Load too high	Reduce load
Number of motor revolutions too high or too low	Rated motor speed, minimum or maximum speed, offset, or reference gain value are set incorrectly	Check parameters and compare setting with motor rating plate
Motor does not turn smoothly	Excessive load	Reduce load
	Motor load changes a lot or displays excessive load points	Reduce load points. Increase motor size or use a larger frequency drive

6.1.2 Malfunctions With An Alarm: Troubleshooting

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.0.0.H	A0.0	Over - current alarm	It has been measured a current greater than its limit	Check if in a transient state the active current reference is increased to high values in a short time. Eventually increase the current limit regulator gain.
A.0.1.H	A0.1	Motor in stall	Drive work in torque or current limit for a time equal to P186 seconds	If the motor has to work in limit for a long time, disable this alarm set C82=0 or lengthen the limit time admitted increasing P186. The motor is in stall because it has not been given sufficient voltage boost at low frequencies: increase the parameter P172. The start-up load is too high: reduce it or increase the rating of motor and drive.
A.1.0.H	A1.0	Loaded default parameters	EEPROM data related to a different core	It's possible to reset this alarm but keep attention: now all parameters have its default value.
A.1.1.H	A1.1	EEPROM Read failure	A Check Sum error occurred while the EEPROM was reading the values. Default values loaded automatically.	Try rereading the values with the EEPROM. The reading may have been disturbed in some way. If the problem continues contact BLU as there must a memory malfunction.
A.1.2.H	A1.2	EEPROM Write failure	When data is being written in the EEPROM the required values are always shown afterwards: an alarm triggers if differences are detected.	Try rewriting the values in the EEPROM. The information may have been disturbed in some way. If the problem continues contact BLU as there must be a memory malfunction.
A.1.3.H	A1.3	EEPROM Read and write failure	Alarms A1.1 and A1.2 appears	There are some problems with EEPROM.
A.2.0.H	A2.0	Motor not fluxed	Magnetic flux (d27) is below the minimum flux set in P52.	Check that the motor is properly connected to the drive. Try to increase parameter P29 (machine magnetizing waiting time) and reduce P52 if necessary as this specifies the minimum flux alarm threshold. Check d27 to ensure that the flux increases when RUN is enabled.
A.3.0.H	A3.0	Power fault	The drive output current has reached a level that has set off an alarm; this may be caused by an overcurrent due to leakage in the wires or the motor or to a short circuit in the phases at the drive output. There may also be a regulation fault.	Check the connection wires on the motor side, in particular on the terminals, in order to prevent leakages or short circuits. Check the motor insulation by testing the dielectric strength, and replace if necessary. Check the drive power circuit is intact by opening the connections and enabling RUN; if the safety switch cuts in, replace the power. If the safety switch cuts in only during operation, there may be a regulation problem (replace along with current transducers) or vibrations causing transient D.C.
A.4.0.H	A4.0	Application alarm	This alarm is application specific. Please refer to specific documentation	

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.5.0.H	A5.0	Motor temperature too high	Connection C46 runs a range of motor heat probes. If C46=1 or 2, a PTC/NTC is being used and its Ohm value (**d41**) has breached the safety threshold (**P95).** If C46 = 3 a digital input has been configured to I23 logical input function and this input is in not active state. If C46=4, a KTY84 is being used: the temperature reading (**d26**) must be higher than the maximum temperature (**P91**).	Check the temperature reading in d26 and then check the motor. With a KTY84, if -273.15 appears the electrical connection towards the motor heat probe has been interrupted. If the reading is correct and the motor is overheating, check that the motor cooling circuit is intact. Check the fan, its power unit, the vents, and the air inlet filters on the cabinet. Replace or clean as necessary. Ensure that the ambient temperature around the motor is within the limits permitted by its technical characteristics.
A.5.1.H	A5.1	Radiator temperature too high	The radiator temperature (d25) is higher than the maximum (P118).	Check the temperature reading on d25 and then check the radiator. If -273.15 is displayed, the electrical connection towards the radiator heat probe has been interrupted. If the reading is correct and the motor is overheating, check that the drive cooling circuit is intact. Check the fan, its power unit, the vents, and the air inlet filters on the cabinet. Replace or clean as necessary. Ensure that the ambient temperature around the drive is within the limits permitted by its technical characteristics. Check parameter P118 is set correctly.
A.5.2.H	A5.2	Brake resistance adiabatic energy protection	The Adiabatic Energy dissipated on Braking resistance during the time selected in **P144** has overcame the threshold set in KJoule in **P142**	Check the correct setting of parameters P140, P142 and P144 compared to the Resistance plate. Check the correct dimensioning of Braking Resistance Maximum Power related to maximum speed, load inertia and braking time.
A.5.3.H	A5.3	Brake resistance dissipated power	The Average Power dissipated on Braking has overcome the threshold set in Watt in **P146**	Check the correct setting of parameters P140, P146 and P148 compared to the Resistance plate. Check the correct dimensioning of Braking Resistance Average Power related to maximum speed, load inertia and braking time
A.5.4.H	A5.4	Motor thermal probe not connected	Thermal probe not detected the presence.	Verify the presence of the connection of the probe and that it is correct.
A.5.5.H	A5.5	Run with T.radiator too high	RUN with Trad>P119	Check the radiator temperature (d25)
A.6.0.H	A6.0	Motor I^2t thermal alarm	The motor electronic overload safety switch has cut in due to excessive current absorption for an extensive period.	Check the motor load. Reducing it may prevent the safety switch cutting in. Check the thermal current setting, and correct if necessary (P70). Check that the heat constant value is long enough (P71). Check that the safety heat curve suits the motor type and change the curve if necessary (C33).
A.7.0.H	A7.0	Auto-tuning test unfinished	The RUN command was disabled during a test. Run command switched off too early.	Reset the alarms and repeat the test by re-enabling it.
A.7.1.H	A.7.1	Speed doesn't reached during autotuning	During autotuning speed control, at the end of acceleration ramp the real speed differs by more than 20% from the theoretical value.	Try to reapeat autotuning test.
A.8.0.H	A8.0	Missing enable logic input from the field	A digital input has been configured to I02 logical input function and this input is in not active state	The external safety switch has cut in disabling drive enable. Restore and reset. The connection has been broken. Check and eliminate the fault. Input function has been assigned, but enable has not been given. Authorise or do not assign the function.

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.8.1.H	A8.1	Watchdog alarm LogicLab	A LogicLab watchdog alarm on slow cycle appears	Check if the LogicLab slow task duration is greater than 500 ms and try to reduce this execution time
A.8.2.H	A8.2	Fast task LogicLab too long	The logicLab fast task is too long in time	Try to reduce the LogicLab fast task execution time under admitted limit. Please refer to the specific documentation.
A.8.3.H	A8.3	Application out of service	There is no valid application running in the drive	Reload the application using OPDExplorer
A.9.0.H	A9.0	Hardware board and firmware are incompatible	Feedback option card and drive firmware incompatible	Check internal values **d62** and **d63** for the firmware and option card codes. There must be some irregularity.
A.9.1.H	A9.1	Sensor presence	Sensor not connected	Check the connection towards the sensor.
A.9.2.H	A9.2	Overspeed (more than 10 consecutive Tpwm)	Overspeed: speed reading higher than threshold set in P51.	In a transient state, the speed reading has exceeded the permitted limit. Adjust the speed regulator gains or raise the limit in P51.
A.9.6.H	A.9.6	Loose speed control	Too big error between speed reference and actual speed	In a transient state the speed read was different more than P56 from reference and also with different sign.
A.A.0.H	A10.0	DC Bus under minimum threshold admitted	Intermediate drive circuit voltage (DC Bus see **d24**) has dropped below the minimum value (**P106**).	Undervoltage may occur when the mains transformer is not powerful enough to sustain the loads or when powerful motors are started up on the same line. Try to stabilise the line by taking appropriate measures. If necessary, enable the BUS support function for mains failure (C34=1). This however can only help motors with light loads.
A.A.1.H	A10.1	Emergency bracking on main supply lost	With connection C34= 3 was been select the emergency brake when main supply is lost. This has occurred	Try to understand why main supply is lost.
A.b.1.H	A11.1	HW detection	Intermediate drive circuit voltage (DC Bus see **d24**) has exceeded the maximum analog thresold value.	The safety switch cuts in mainly due to excessively short braking times. The best solution is to lengthen the braking times. An overvoltage in the mains may also trigger the safety switch. If the drive is fitted with a braking circuit, check that the resistance value is not too high to absorb the peak power. If the resistor is not too hot, check the resistor and connection continuity and ensure that the circuit functions correctly.
A.b.2.H	A11.2	SW detection	Intermediate drive circuit voltage (DC Bus see **d24**) has exceeded the maximum value (**P107**).	
A.b.3.H	A11.3	HW + SW detection	A11.0 and A11.1 appears	
A.C.0.H	A12.0	Software alarm	C29 different from 1	Check and enable connection C29 “Drive software enable”
A.C.1.H	A12.1	Run whitout power soft start	RUN without Power Soft start	Check why the Power Soft start isn’t enabled With DC input (continuous voltage input DC BUS) check that the connection C53 “MAIN_SUPPLY_SEL” is correct.

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.d.0.H	A13.0	Rectifier bridge problem	The bridge that enables the line by gradually loading the DC bus condensers has not managed to load the intermediate drive circuit sufficiently within the time set (P154).	Check the voltage of the three input phases. Try switching off and then back on, measuring the DC Bus level (with the monitor or tester). If the problem repeats, contact BLU as there must be a soft start circuit malfunction.
A.d.1.H	A13.1	Safe Torque Off / Power board fault	Safe Torque Off: +24V are missing in connector S1. For this reason it's enabled certified STOP function Power board fault: problem to the power board	Bring +24V to connector S1. If the user want to use the Safe Torque Off function without alarms, it's necessary to set C73=1. If there is no present the Safe Torque Off function in the drive, this alarm indicates a power board problem.
A.d.2.H	A.13.2	Excessive Ripple on DC Bus	It was detect a big variation on DC bus	Verify if all three main phases are present on connector R,S,T and their rms value.
A.d.3.H	A13.3	New STO: only one STO channel activated	Only one STO channel is working. The drive is waiting the second one, in the meantime isn't possible to enable the power stage.	Check if the correct voltage is applied to safety connector
A.d.4.H	A13.4	New STO: Fault on at least one safety channel	At least one safety channel doesn't work well	Contact BLU assistance.
A.d.5.H	A13.5	New STO: monitor failure	The new STO management was been enable with C58=1 but the monitor channel doesn't work well	Contact BLU assistance for understand if the new STO function can be enabled in this drive.
A.E.0.H	A14.0	Motor phase inverted	During autotuning was been detected that motor phase are not connected in the same order of feedback	Swap over two phases and repeat the connection tests.
A.E.1.H	A14.1	Motor not connected	During autotuning was been detected that drive and motor aren't connected properly	Check motor phases
A.F.0.H	A15.0	Wrong number of Motor/Sensor poles	Motor/sensor parameters being written	Number of motor poles (P67) set incorrectly or more sensor poles (P68) than motor poles have been set.
A.F.1.H	A15.1	Simulated encoder pulses	Simulated Encoder pulses	Number of revolutions per pulse selected (C51) is not compatible with the maximum speed (P65). See "Feedback Option" enclosure.
A.F.2.H	A15.2	Excessive magnetizing current measured	During autotuning was been measured a magnetizing current greater than 80% of motor nominal current.	Check the coherence between the motor and its related defining parameters (P61,P62 and P63), especially motor phase connection (star or triangle)
A.F.3.H	A15.3	Wrong Sensor pulses number read in Autotest	An error occurred during the "Sensor and motor poles" test.	See specific test description in the "Feedback Option" enclosure.
A.F.4.H	A15.4	Sensor tune failed	It's detected error in setting related to the sensor compensation offset and gain.	If th is alarm appeared during autotuning C41, repeat the test. Otherwise check parameters P164,P165,P166 and P170,P171,P172.

6.1.3 MiniOPDE's Specific Alarms

The new MiniOPDE consists of 2 fast-communicating microprocessors. One microprocessor is located in the Regulation board (as in standard OPDE); the second one is located in the Power board.
Thanks to this new configuration, the MiniOPDE features some types of alarms that are not included in the OPDE series. These alarms have been renamed, so as to guarantee maximum compatibility with those who already use the OPDE series.

MiniOPDE's specific alarms are listed in table:

Alarms		Description	Corrective action
Hex	Dec		
A.10.0	A.A.0	Minimum voltage of Power circuit	Undervoltage may occur when the mains transformer is not powerful enough to sustain the loads or when powerful motors are started up on the same line. Try to stabilise the line by taking appropriate measures. If necessary, enable the BUS support function for mains failure (C34=1). This however can only help motors with light loads.
A.10.5	A.A.5	Overcurrent alarm detected by Power board	Check the drive power circuit is intact by opening the connections and enabling RUN; if the safety switch cuts in, replace the power. If the safety switch cuts in only during operation, there may be a regulation problem (replace along with current transducers) or vibrations causing transient D.C.
A.10.6	A.A.6	Communication alarm: communication fault with Power board	With this alarm, contact BLU assistance.
A.10.7	A.A.7	Alarm due to Power board fault (Micro's watchdog)	With this alarm, contact BLU assistance.
A.10.8	A.A.8	Alarm due to wrong power supply in the Power board (15V wrong)	Check for overloads, even very short, the 24Vdc control terminal.
A.10.9	A.A.9	Overcurrent alarm for leakage currents to ground	Check the connection wires on the motor side, in particular on the terminals, in order to prevent leakages or short circuits. Check the motor insulation by testing the dielectric strength, and replace if necessary.
A.10.10	A.A.A	(Reserved)	
A.10.11	A.A.B	Brake fault alarm	Check for short circuits in the connections of the braking resistors or resistor values lower than the minimum required. Disconnect the connections of the braking resistor, if the problem persists, contact BLU.
A.10.15	A.A.F	Power board generic alarm	With this alarm, contact BLU assistance.

These alarms take the form of sub-alarms of alarm A.10, to indicate that they all depend on the Power board.

7 DISPLAY

7.1 PHYSICAL DISPOSITION

The keypad has three buttoms, “**S**” (selection), “**+**” (increase), “**-**“ (reduce) and a four numbers and half display, with the decimal points and the sign “**-**“.

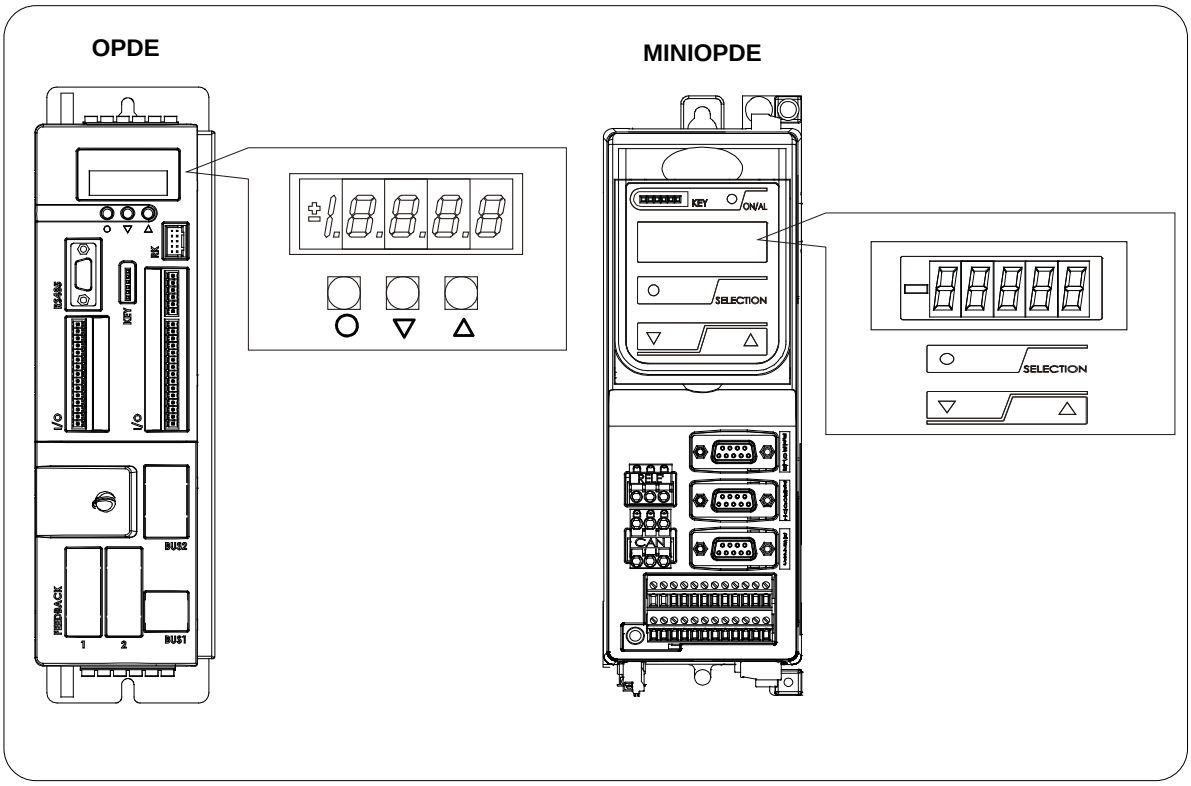


FIG. 1 (Physical disposition)

7.2 LAYOUT OF THE INTERNAL VARIABLES

The converter is a full digital, then other hardware settings are not necessary, if not made in factory, and the setups, settings and visualizations, all digital, they go effect through the keypad and the display, or by serial line or by fieldbus. For easy access of formulations and mnemonics all the accessible greatnesses have been grouped in the following menu:

Parameters (**PAR**)
Application Parameters (**APP**)
Connections (**CON)**
Internal values (**INT**)
Allarms (**ALL**)
Digital Input (**INP**)
Digital Output (**OUT**)
Utilities Commands (**UTL**)
Fieldbus commands (**FLB**)

In each group the variables are arranged in progressive order and only those that are actually used are displayed

7.2.1 Parameters (Par)

They are definite parameters of variables of setting whose numerical value has an absolute meaning (for example: P63 = nominal frequency motor = 50 Hz) or they are of proportional value to the limit range (for example: P61 = motor nominal current = 100 % of the drive nominal current). They are distinguished in **free** parameters, modifiable always also online, **reserved**, modifiable only offline and after access code to the reserved parameters (P60), or **reserved for the BLU**, visible after having written the access code BLU parameters (P99) and modifiable only offline. The characteristics of each parameter are recognizable from the **code of identification** as below:

Offline= not in run / Online=in run

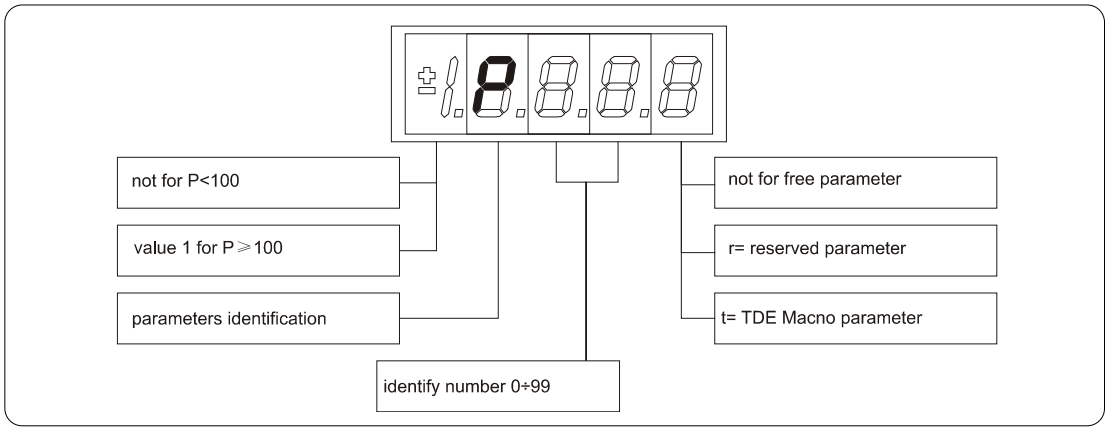


FIG. 2 (Parameters PAR)

For example: P60 r = parameter 60: reserved
1P00 t = parameter 100 BLU reserved

7.2.2 Application Parameters (App)

For their definition refer to the description of the parameters. They are distinguished in free parameters, some modifiable always (Online), other only to converter not in run (offline), reserved, modifiable only offline and after access code to the reserved parameters (P60). The characteristics of each parameter are recognizable from the code of identification as below:

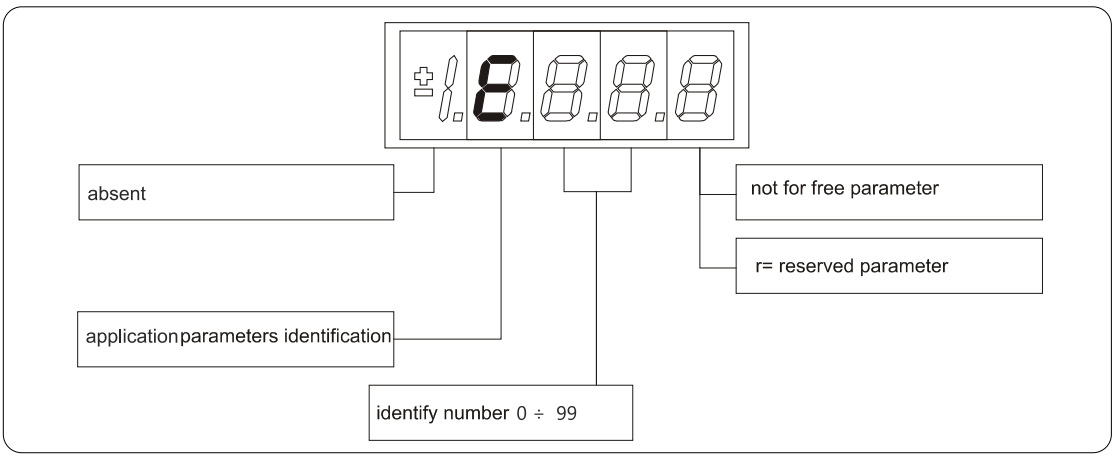


FIG. 3 (Application Parameters PAR)

For example: E03 r = application parameter 03: reserved

7.2.3 Connections (Con)

They are certain connections that variables approach that are of numerical value comes connected to a function or a clear command {for example: rounded ramp insertion C27= 1; or no rounded ramp, C27= 0; or save parameters on EEPROM memory, C63= 1}. They are in **free** connections, some of the like modifiable always (Online), other with converter in stop (offline) and **reserved**, modifiable only offline and after access code to the reserved parameters (P60), or reserved for the BLU, visible after having written the access code BLU parameters (P99) and modifiable only offline.

The characteristics of each connection are individually recognizable of **identification code** as under report:

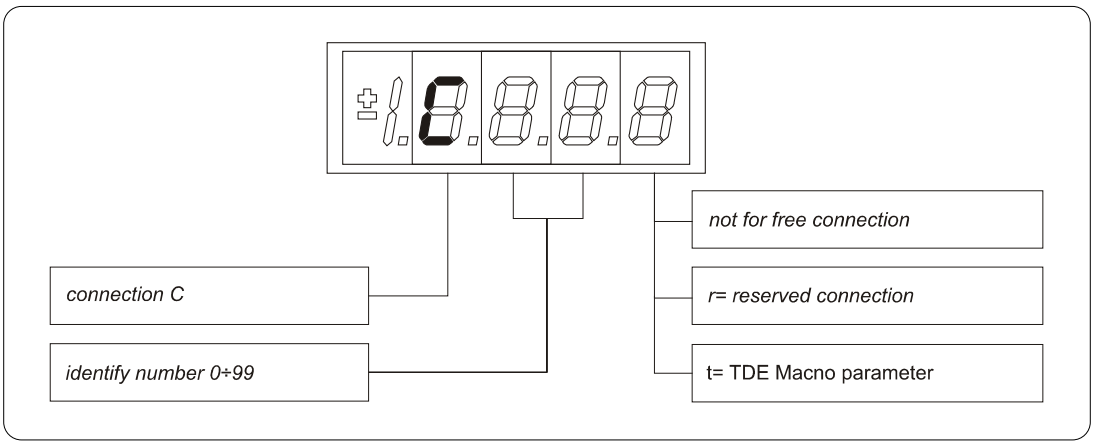


FIG. 4 (Connections CON)

7.2.4 Allarms (All)

Overall functions of protection of the converter, of the motor or in the application whose status to **active alarm** or **not active alarm** it may be visualized in the display. The actived protection, stops the converter and does flash the display, excepted if it is disabled. With a single visualization is possible have all the indications with the following:

For ex. **A03.L = power fault doesn't activate**

The alarms are all memorized and so they remain till that is not missing the cause of the alarm and have been resetted (input of resetting alarms activate) or (C30 = 1).

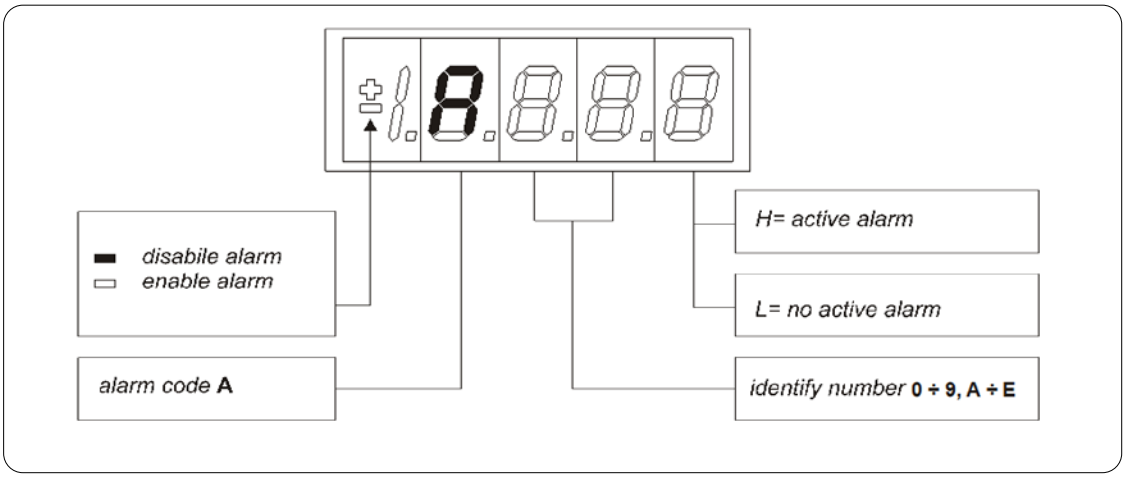


FIG. 5 (Allarms ALL)

7.2.5 Internal Values (Int)

Overall functions of protection of the converter, of the motor or in the application whose status to active alarm or non active alarm it may be visualized in the display. The actived protection, stops the converter and does flash the display, excepted if it is disabled. With a single visualization is possible have all the indications with the following:

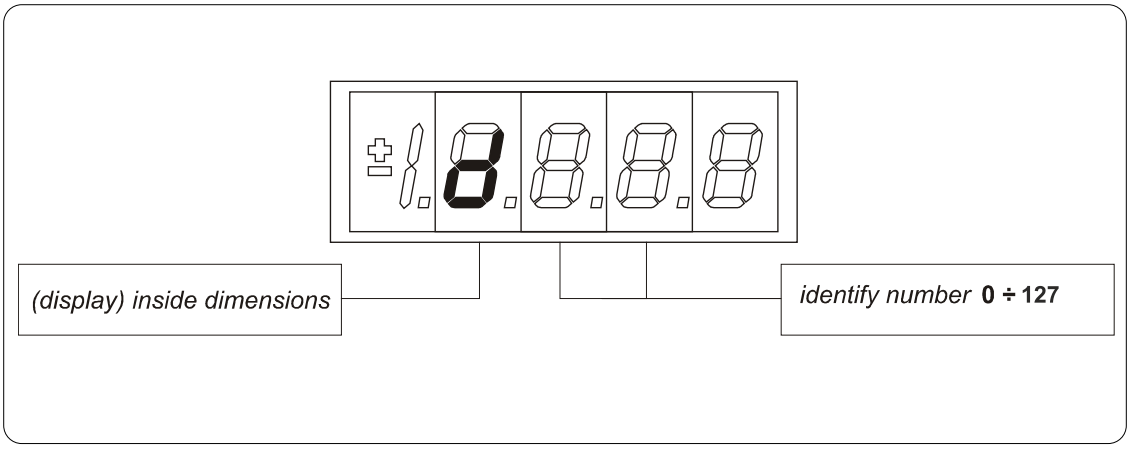


FIG. 6 (Internal Values INT)

7.2.6 Logic Functions of Input (Inp)

The visualization between I00 and I31 is the status of the logical functions that is assigned in the all digital inputs of the regulation. Code of identification (input) logical input.

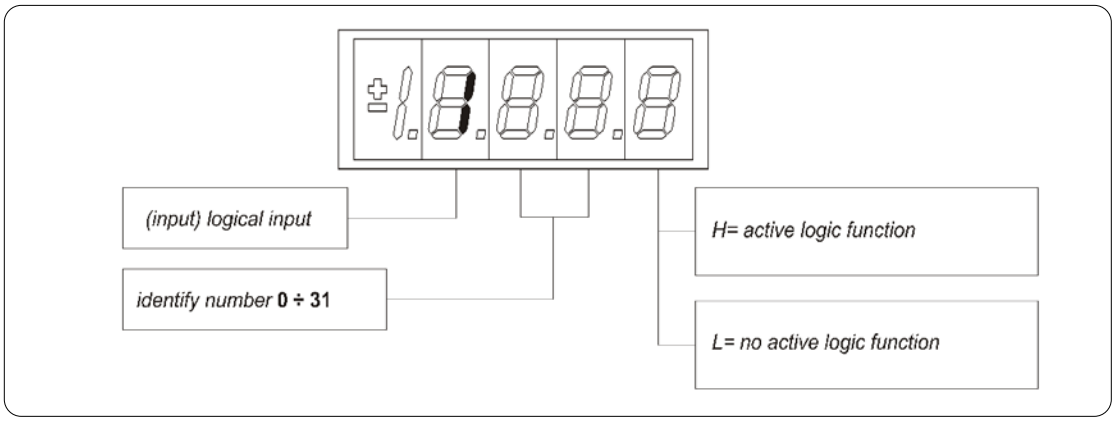


FIG. 7 (Logics functions of input INP)

7.2.7 Logic Functions Of Output (Out)

Visualization of the status, of the logical functions (for example: drive ready, converter in run) scheduled in the control, that may or may not be assigned of predicted digital output. Code of identification:

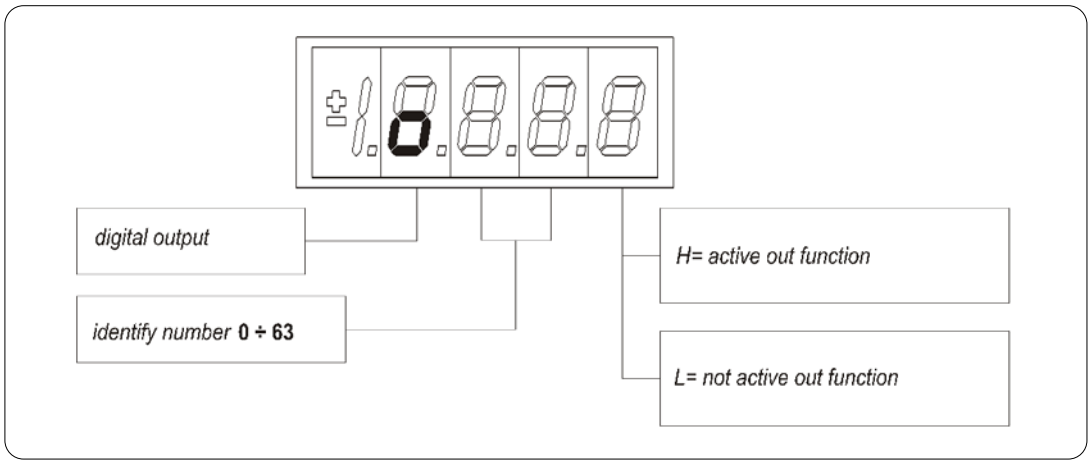


FIG. 8 (Logics functions of output OUT)

7.2.8 Utilities Commands (UTL)

They are certain connections that variables approach that are of numerical value comes connected to a function or a clear command. They are only in **free** connections.The characteristics of each connection are individually recognizable of **identification code** as under report:

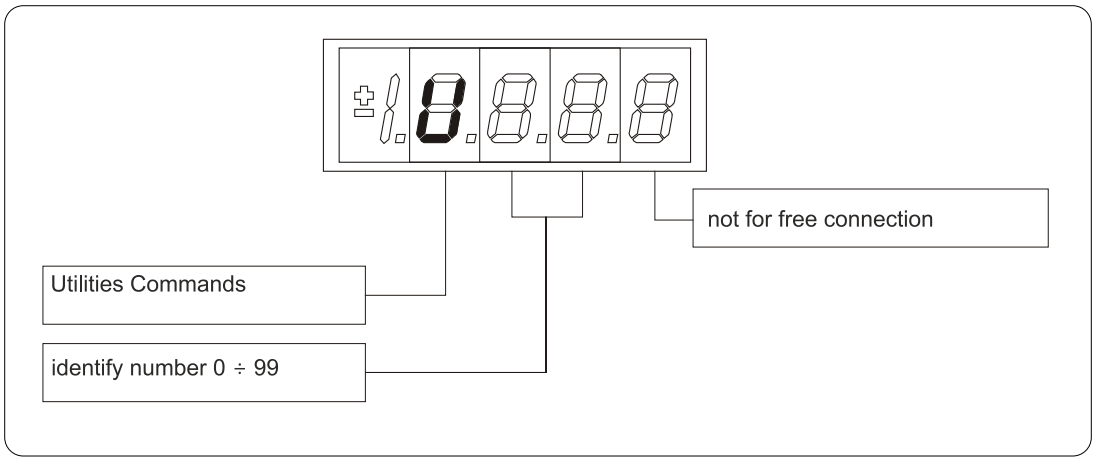


FIG. 9 (Utilities Commands UTL)

7.2.9 Fieldbus Parameters (FLB)

FLB menu refers to parameters related to Fieldbuses management that was previously accessible only by OPDExplorer as they weren't associated to any “standard” parameter, connection or extra parameter and so not accessible by keypad. Now they are grouped in this new menu so they can be viewed and changed (if not read-only) by keypad.

Notice that all parameters in FLB menu are not protected by any key nor by run status so they can be changed at any time. Code of identification:

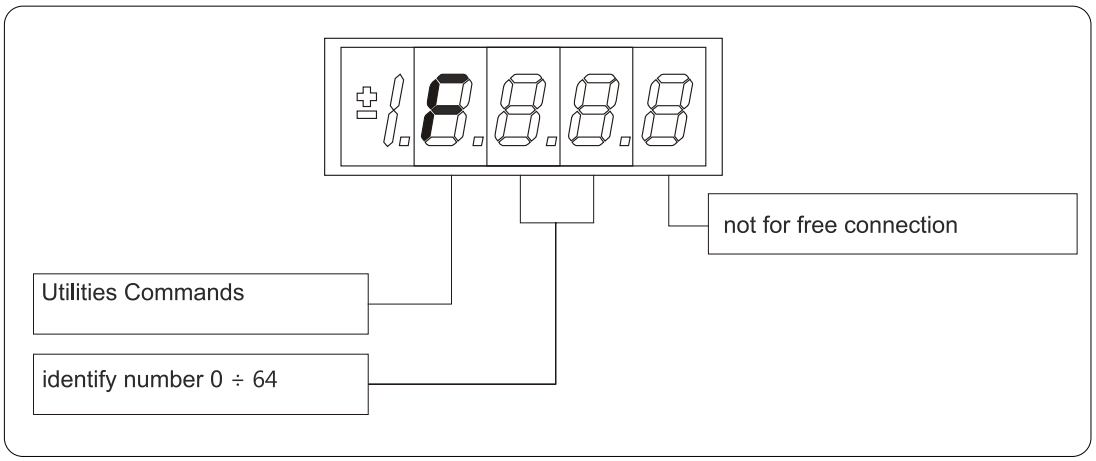


FIG. 10 (Fieldbus Parametrs FLB)

7.3 IDLE STATE

It is the status that the display assumes right after the lighting or when none is programming (P112 seconds, 10 of default, after the last movement, except that is not is visualizing an internal variables, or an input, or a digital output). When the keypad is on tat the status rest, if the converter is not in run comes visualized “STOP”; if the converter is in run comes visualized the internal value selected with C00 connection or the status “run”. If the converter finds the status alarm, for intervention of an or more protections, the written on the keypad start to flash and they come visualized all the active alarms (one by one).

7.4 MAIN MENU

Leaving from the status of rest pressing the “S” key the principal menu is gone into of circular type that contains the indication of the type of visualizable variables:

PAR = parameters
APP = application parameters
CON = internal connections
INT= internal values
ALL= allarm
INP = digital input
OUT = digital output
UTL= utilities commands
FLB= fieldbus parameters

To change from a list to another enough is necessary to use the “+” or “” keys and the passage will happen in the order of figure. Once select the list you pass on the relative sub-menu pressing “S”; the reentry to the mainmenu from the following visualizations will be able future through the pressure of the key “S” simple or double in brief succession (less in a second), like showed after. The return to the status of rest comes instead automatically after 10 (P112) seconds of inactivity is from some sub-menu that goes by the main menu.

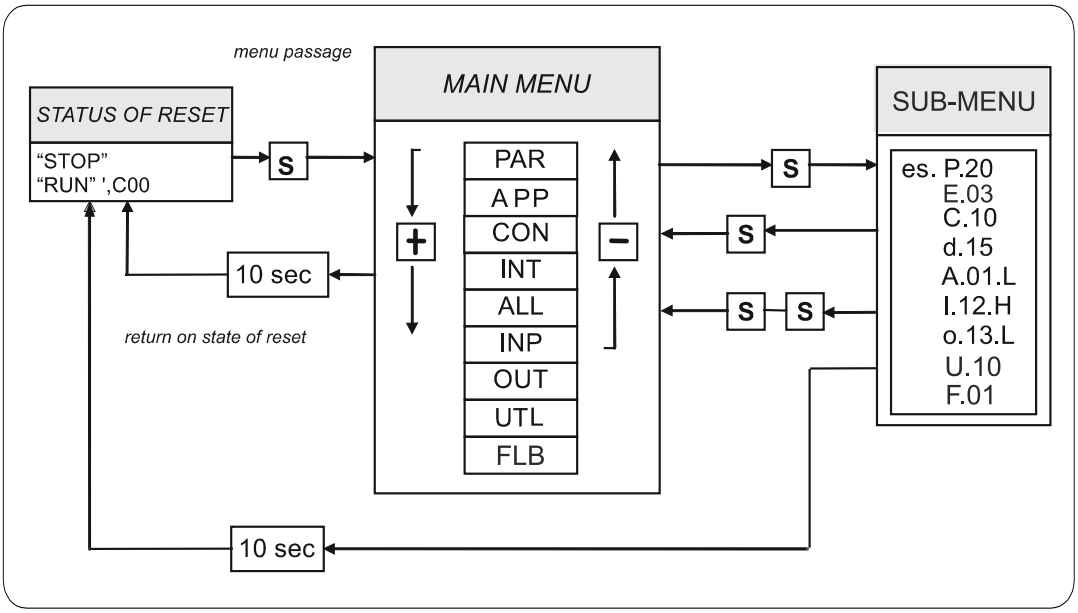


FIG. 11 (Main Menu)

7.4.1 Sub-Menu Of Parameters, Application Parameters And Connections Management (Par, App E Con)

From "**PAR**" or "**CON**" You enter into the sub-menu list pressing "S"; once entered into the list is able look through the parameters or the existing connections by pressing the keys "**+**" or "**–**" to move in increase or in decrement; even in this case the list is circular. At the number corresponding to the various parameters or connections appear the letter "**r**" if they are reserved, "**t**" if reserved in the BLU and the letter "**n**" if it modification requires that the converter in not in run (offline); all the reserved parameters are of type "**n**" modifiable only by stop (offline). If You pressed the key "**S**" comes visualized the value of the parameter or of the connection that may be read; at this point repress "**S**" once You return to the sub-menu list, press twice "**S**" in fast succession (less 1 seconds), return to the main menu. The system returns automatically to the status of rest and after 10 seconds of have past inactivity. To modify the value of the parameter or of connection once entered into visualization it necessary press both keys "**+**" and "**–**"; in that moment it starts to flash the decimal point of the first figure to the left warning that from that moment the movement of the keys and "**+**" modifies the value; the change of value may only by stop if the parameter is of kind "**n**" and only after having set up the code of access P60, if the parameter is of the kind "**r**", only after having set up the code of P99 (access for the reserved parameters BLU, kind "**t**". The parameters and the reserved connections BLU doesn't appear in the list if doesn't call the code of P99. Once the value is corrected You press the key "**S**" return to the sub-menu list making operational the parameter or the corrected connection; if after correct the value want go out without change the values wait 10 seconds; if the value is no touched for the exit press again the "**S**" key (it is operative the same original value). About parameters and connections, the return to the status of rest display is in automatically way after 10 seconds from any kind of visualization.

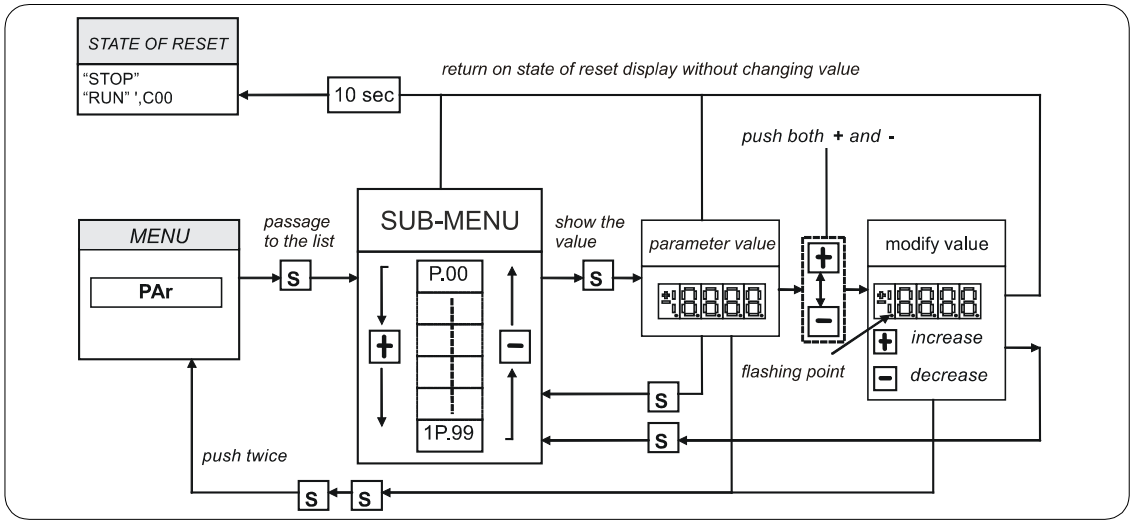


FIG. 12 (Sub-menu management parameters PAR)

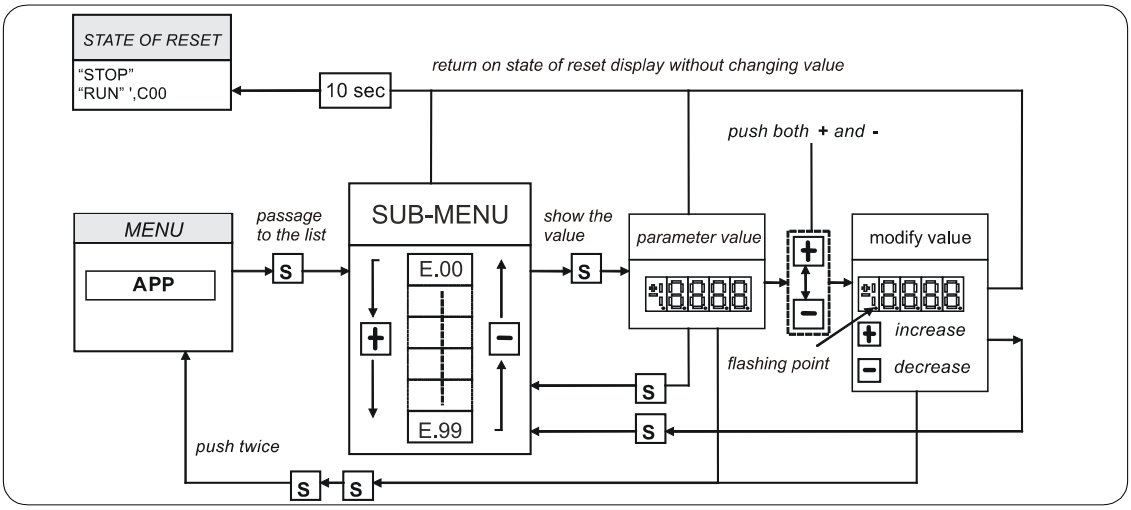


FIG. 13 (Sub-menu management application parameters APP)

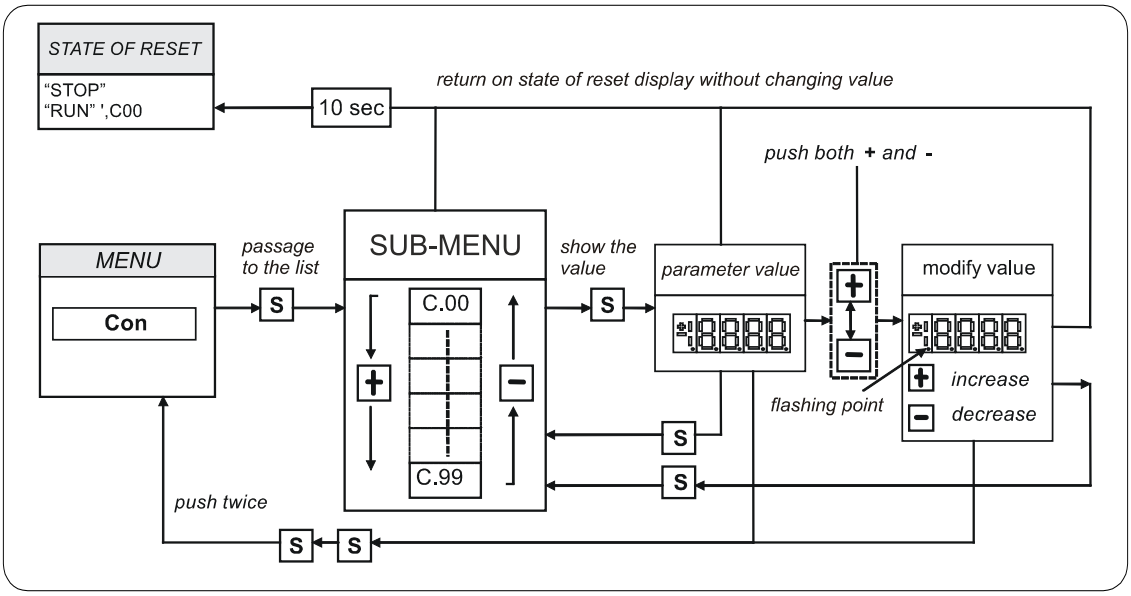


FIG. 14 (Sub-menu management connections CON)

7.4.2 Visualization of the Internal Values (INT)

From INT You enter into the list of sub-menu of the internal values pressing “S”. In the list you are moving with the keys “+” or “–” till that appearing address of values wanted visualize “d x x”; pressing “S” disappears the address and appear the value of the dimension. From this status You go back to sub-menu list, repressing “S”, and go again to the main menu repressing “S” twice in fast succession; from the menu and from the sub-menu. You return automatically to the status of rest after a time of 10 seconds.

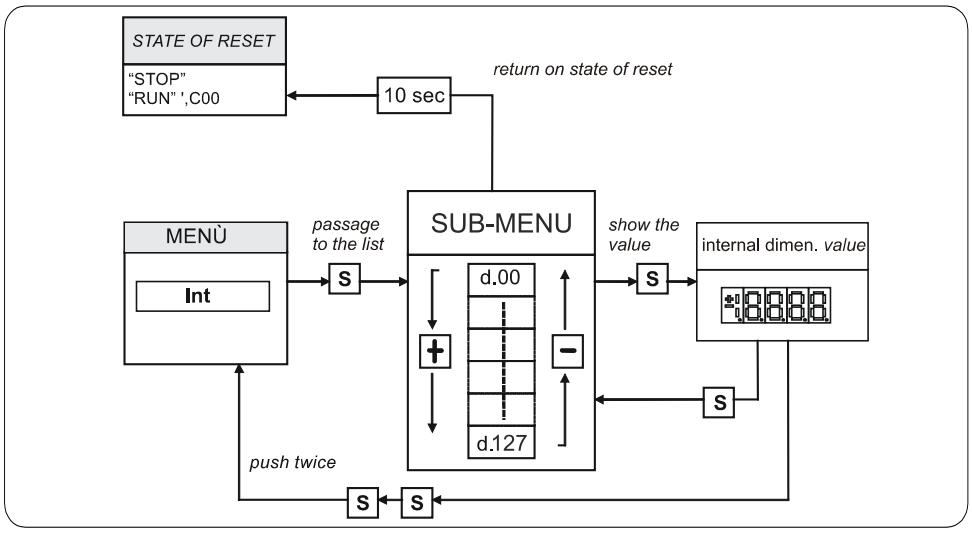


FIG. 15 (Visualization of the internal values INT)

7.4.3 Alarms (ALL)

From ALL You enter into of sub-menu list of the alarms pressing “S”. From the corresponding sub-menu with the keys “+” and “–” move all addresses desired for the alarms; with this, in the box to the right, appears the status of the alarm “H” if active, “L” if don’t. If the alarm has been disabled; in this case too with the active status doesn’t appear any stop of the regulation, the address of the alarm is preceded by the sign “–”.
To exclude the event of an alarm You must enter into the menu to modify both the keys “+” and “–” and when the flashing point appears of the first number You can enable or disable the alarm with the keys “+” or “–”; if the alarm is disabled appears the sign the “–” to the left of the writing “A.XX.Y”.
From the status of modification returns to the list of sub-menu and You return operative the select made pressing “S”, from the menu and from the sub-menu You turn automatically to the status of rest after a time closed to 10 seconds.

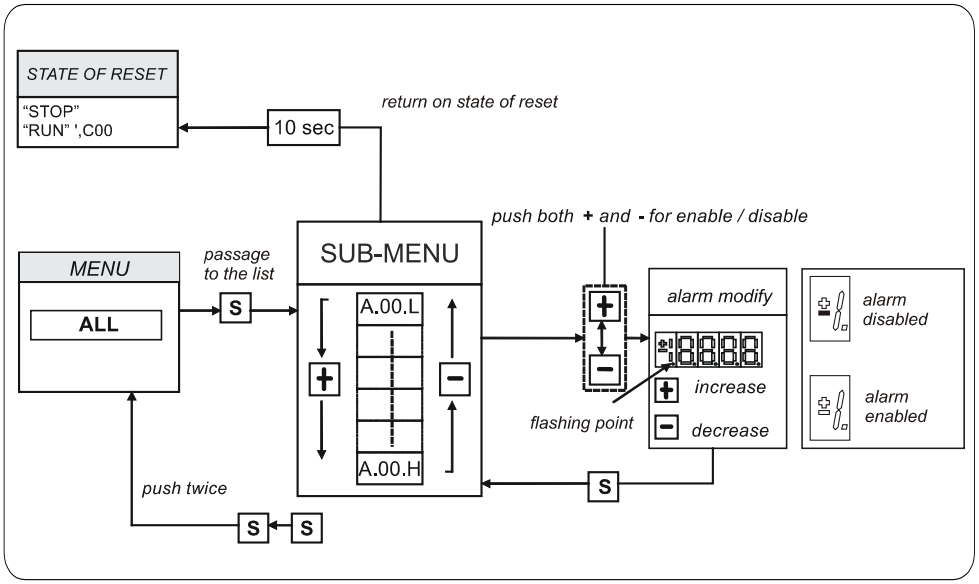


FIG. 16 (Alarms ALL)

7.4.4 Visualization of the Input and Output (Inp and Out)

From the INP or from the OUT You enter into corresponding list of sub-menu pressing “**S**”. From the corresponding list of sub-menu with the keys “**+**” and “**–**” move to the address desired for the digital input (i) and the output (o); together to this, in the box, appear the status: “**H**” if activate, “**L**” if not active. From this status You returns to the main menu pressing “**S**”.

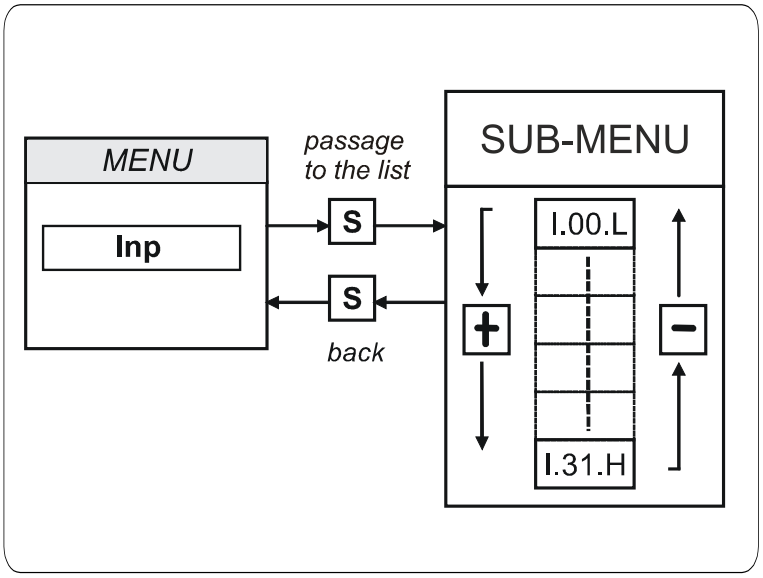


FIG. 17 (Digital input INP)

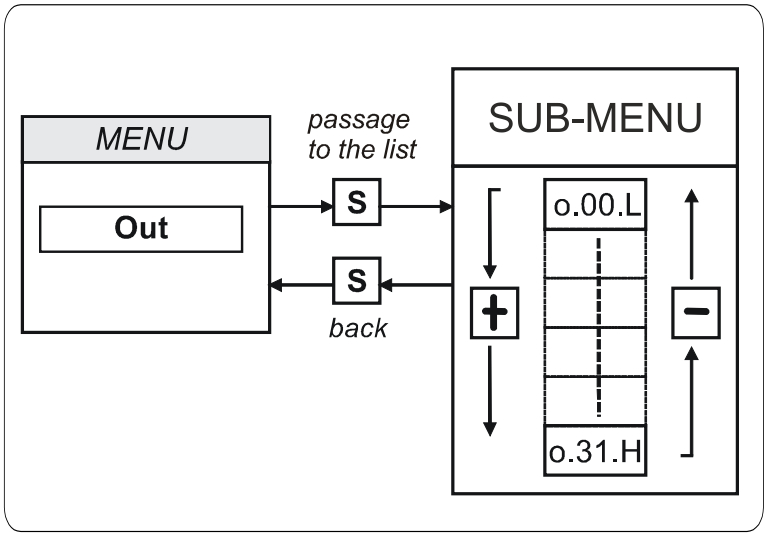


FIG. 18 (Digital output OUT)

7.5 PROGRAMMING KEY

The programming key device allows to transfer parameters from and to the Drive inverter or between inverters. The data are stored in a EPROM type memory, so **battery backup is not necessary**. The switch put on the key upper front side allows to protect the stored data against possible writing procedures.

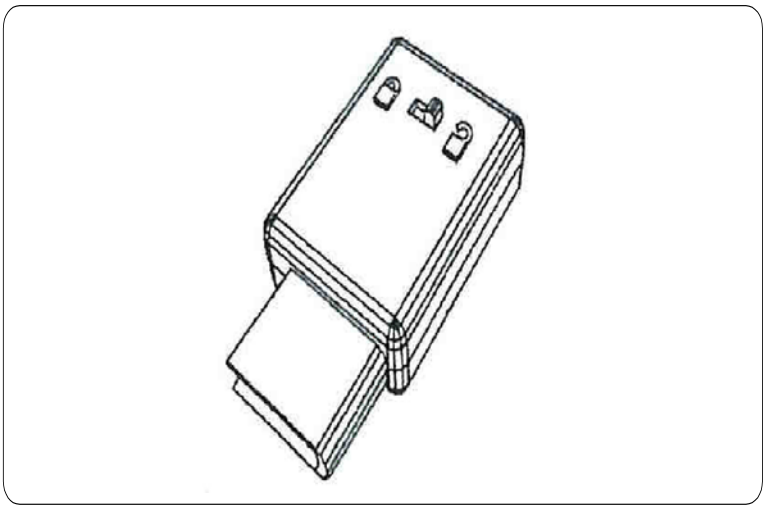


FIG. 19 (Keypad)

Use method:

Parameter transmission from the key to the inverter:

Plug the key into the suitable connector;
Select, via the keypad ▼ and ▲, the "**Load**" function and press "**S**".

During the data transfer the "**RUNN**" indication is displayed.
If the key contains invalid parameters, the factory preset parameters will be used and the message "**Err**", will be dispalyed for 4 s. Otherwise, data will be permanently stored and the confirmation message "**donE**" will be displayed for 2 s.

Parameter transmission from the inverter to the key:

Plug the key into the suitable connector;
Select, via keypad ▼ and ▲, the "**Save**" function and press "**S**".
If the key is write-protected. The control is interrupted and the message "**Prot**" is displayed for 4 s.
Otherwise, inverter parameters are stored on the key and, at the end of the operation, the message "**RUNN**" and the message "**donE**" will be displayed for 2 s to confirm the operation.
By using the key you can store or transfer only the standard parameters. The parameters of some applications (positioner, etc..) can not be saved or transferred via the programming key. The programming key does not save the firmware but only the parameters

8 LIST OF PARAMETERS

Name	Description	Min	Max	Default	UM	Scale
PRC_START_UP_SPD_REF	P00 - Quick start application digital speed reference	-100.0	100.0	0	% MOT_SPD_MAX	163.84
KP_AI1	P01 - Corrective factor for analog reference 1 (AUX1)	-400.0	400.0	100	%	10
OFFSET_AI1	P02 - Corrective offset for analog reference 1 (AUX1)	-100.0	100.0	0	%	163.84
KP_AI2	P03 - Corrective factor for analog reference 2 (AUX2)	-400.0	400.0	100	%	10
OFFSET_AI2	P04 - Corrective offset for analog reference 2 (AUX2)	-100.0	100.0	0	%	163.84
KP_AI3	P05 - Corrective factor for analog reference 3 (AUX3)	-400.0	400.0	100	%	10
OFFSET_AI3	P06 - Corrective offset for analog reference 3 (AUX3)	-100.0	100.0	0	%	163.84
KP_SENS2	P07 - Second sensor amplitude compensation	0.0	200.0	100	%	163.84
OFFSET_SIN_SENS2	P08 - Second sensor sine offset	-16383	16383	0		1
OFFSET_COS_SENS2	P09 - Second sensor cosine offset	-16383	16383	0		1
OFFSET_VF	P10 - Offset for high precision analog reference value	-19999	19999	0	1/100 mV	1
SYNC_REG_KP	P11 - CanOpen SYNC loop regulator Proportional gain	0	200	5		1
SYNC_REG_TA	P12 - CanOpen SYNC loop regulator lead time constant	0	20000	400		1
KP_AI16	P13 - Corrective factor for 16 bit analog reference (AUX16)	-400.0	400.0	100	%	10
OFFSET_AI16	P14 - Corrective offset for 16 bit analog reference (AUX16)	-100.0	100.0	0	%	163.84
TF_LI6-7-8	P15 - I06,07,08 logical inputs digital filter	0.0	20.0	2.2	ms	10
RES2_POLE	P16 - Number of absolute sensor2 poles	1	160	2		1
ENC2_PPR	P17 - Number of encoder2 pulses/revolution	0	60000	1024	pulses/rev	1
PRC_CW_SPD_REF_MAX	P18 - Max. CW speed reference value limit	-105.02	105.02	105.02	% MOT_SPD_MAX	163.84
PRC_CCW_SPD_REF_MAX	P19 - Max. CCW speed reference value limit	-105.02	105.02	105.02	% MOT_SPD_MAX	163.84
SPD_LOOP_BW	P20 - Speed loop bandwidth	0.1	200.0	5.0	Hz	10.0
CW_ACC_TIME	P21 - CW acceleration time	0.01	199.99	10	s	100
CW_DEC_TIME	P22 - CW deceleration time	0.01	199.99	10	s	100
CCW_ACC_TIME	P23 - CCW acceleration time	0.01	199.99	10	s	100
CCW_DEC_TIME	P24 - CCW deceleration time	0.01	199.99	10	s	100
TF_RND_RAMP	P25 - Rounded filter time constant	0.001	10.0	0.1	s	1000
I_RELAY_THR	P26 - Current/power relay cut-in threshold	0.2	150.0	100	%	40.96
TF_I_RELAY	P27 - Filter time constant for current/power relay	0.1	10.0	1	s	10
MOT_WAIT_DEMAGN	P28 - Motor demagnetization waiting time	0	3000	0	ms	1
MOT_WAIT_MAGN	P29 - Motor magnetization waiting time	50	3000	300	ms	1
DEC_TIME_EMCY	P30 - Emergency brake deceleration time	0.01	199.99	10	s	100
END_SPD_REG_KP	P31 - KpV final speed regulator proportional gain	0.1	400.0	4		10
END_SPD_REG_TI	P32 - TiV final speed regulator lead time constant	0.1	3000.0	80	ms	10
END_SPD_REG_TF	P33 - TfV final speed regulator (filter) time constant	0.0	25.0	0.8	ms	10
START_SPD_REG_TF	P34 - TfV initial speed regulator (filter) time constant	0.0	25.0	0.8	ms	10
PRC_FLX_REF	P35 - Flux Reference	0.0	120.0	100	% MOT_FLX_NOM	40.96
V_REF_COEFF	P36 - Kv Max operating voltage multiply factor	0.0	100.0	100		327.67
FLW_ERR_MAX_LSW	P37 - Maximum tracking error (less significative part)	-32767	32767	32767	ppr	1
POS_REG_KP	P38 - Kv position loop proportional gain	0.0	100.0	4		10
FLW_ERR_MAX_MSW	P39 - Maximum tracking error (less significative part)	0	32767	0	rpm	1
PRC_DRV_I_PEAK	P40 - Current limit	0.0	250.0	200	% DRV_I_NOM	40.96
PRC_MOT_T_MAX	P41 - Maximum torque at full load	0.0	800.0	400.0	% MOT_T_NOM	40.95
PRC_DRV_CW_T_MAX	P42 - Maximum torque in the positive direction of rotation	0.0	400.0	400.0	% MOT_T_NOM	40.96
PRC_DRV_CCW_T_MAX	P43 - Maximum torque in the negative direction of rotation	-400.0	-0.0	-400.0	% MOT_T_NOM	40.96

Name	Description	Min	Max	Default	UM	Scale
PRC_SPD_THR_GAIN_CHG	P44 - End speed for speed PI gain change	0.0	100.0	0	% MOT_SPD_MAX	163.84
START_SPD_REG_KP	P45 - KpV initial speed PI proportional gain	0.1	400.0	4		10
START_SPD_REG_TI	P46 - TiV initial speed PI lead time constant	0.1	3000.0	80	ms	10
DO_SPD_REACH_THR	P47 - Speed threshold for logic output o.16	0.0	100.0	0	% MOT_SPD_MAX	163.84
RES2_TRACK_LOOP_BW	P48 - Tracking loop bandwidth direct decoding of resolver2	100	10000	1800	rad/s	1
RES2_TRACK_LOOP_DAMP	P49 - Damp factor Traking loop resolver2	0.00	5.00	0.71		100
DO_SPD_MIN_THR	P50 - Minimum speed for relay	0.0	100.0	2.0	% MOT_SPD_MAX	163.84
PRC_MOT_SPD_MAX	P51 - Maximum speed for alarm	0.0	125.0	120.0	% MOT_SPD_MAX	163.83
PRC_FLX_MIN	P52 - Minimum Flux admitted	0.0	100.0	2	% MOT_FLX_NOM	40.96
DRV_I_NOM	P53 - Rated drive current	0.0	3000.0	0	A	10
NOTCH_FREQ	P54 - Notch nominal frequency	0.0	2000.0	0	Hz	10
NOTCH_BW	P55 - Notch bandwidth	0.0	3000.0	0	Hz	10
PRC_LSE_CTR_MAX_ERR	P56 - Max speed error admitted in control	0.1	400.0	400.0	% MOT_SPD_MAX	40.96
PRC_AO1_10V	P57 - % value of 10V for analog output A	100.0	400.0	200	%	10
PRC_AO2_10V	P58 - % value of 10V for analog output B	100.0	400.0	200	%	10
HYST_DO_SPD	P59 - Minimum and maximum speed reached output hysteresis	0.0	100.0	1.0	% MOT_SPD_MAX	163.84
RES_PAR_KEY	P60 - Access Key to reserved parameters	0	65535	0		1
PRC_MOT_I_NOM	P61 - Rated motor current	10.0	100.0	100	% DRV_I_NOM	327.67
MOT_V_NOM	P62 - Rated motor voltage	100.0	1000.0	380	Volt	10
MOT_F_NOM	P63 - Rated motor frequency	10.0	1000.0	50.0	Hz	10
PRC_MOT_V_MAX	P64 - Max. operating voltage	1.0	200.0	100	% MOT_V_NOM	40.96
MOT_SPD_MAX	P65 - Max. operating speed	50	60000	2000	rpm	1
MOT_COS_PHI	P66 - Nominal power factor	0.500	1.000	0.894		1000
MOT_POLE_NUM	P67 - Number of motor poles	1	12	4		1
RES_POLE	P68 - Number of absolute sensor poles	1	12	2		1
ENC_PPR	P69 - Number of encoder pulses/revolution	0	60000	1024	pulses/rev	1
PRC_MOT_I_THERM	P70 - Motor thermal current	10.0	110.0	100	% PRC_MOT_I_NOM	10
MOT_TF_THERM	P71 - Motor thermal time constant	1	2400	180	s	1
PRC_MOT_I_T_NOM	P72 - Nominal torque current	5.0	100.0	95.2	% PRC_MOT_I_NOM	327.67
PRC_MOT_I_FLX_NOM	P73 - Nominal flux current	5.0	100.0	30.2	% PRC_MOT_I_NOM	327.67
T_ROTOR	P74 - Rotor time constant Tr	10	10000	200	ms	1
T_STATOR	P75 - Stator time constant Ts	0.0	50.0	9.1	ms	10
PRC_DELTA_VRS	P76 - Voltage drop due to stator resistor	1.0	25.0	2.0	% MOT_V_NOM	327.67
PRC_DELTA_VLS	P77 - Voltage drop due to leakage inductance	5.0	100.0	20.0	% MOT_V_NOM	327.67
DCBUS_THR	P79 - DC Bus threshold for logic output o25	220.0	1200.0	800	V	10
V_REG_KP	P80 - Kpi voltage regulator proportional gain	0.1	100.0	10.0		10
V_REG_TF	P82 - Tfi voltage regulator (filter) time constant	0.0	1000.0	12.0	ms	10
I_REG_KP	P83 - Kpc current regulator proportional gain	0.1	100.0	2.6		10
I_REG_TI	P84 - Tic current regulator lead time constant	0.0	1000.0	9.1	ms	10
I_REG_TF	P85 - Tfc current regulator (filter) time constant	0.0	25.0	0	ms	10
DCBUS_REG_KP	P86 - Kp3 Bus control proportional gain	0.05	10.00	3.5		100
AC_MAIN_SUPPLY	P87 - Main Supply voltage	180.0	780.0	400	V rms	10
MAXV_VF	P88 - High precision analog speed reference value: Voltage matches max. speed	2500	10000	10000	mVolt	1
RES_TRACK_LOOP_BW	P89 - Tracking loop bandwidth direct decoding of resolver	100	10000	1800	rad/s	1
RES_TRACK_LOOP_DAMP	P90 - D Traking loop bandwidth	0.00	5.00	0.71		100
MOT_TEMP_MAX	P91 - Maximum motor temperature (if read with KTY84)	0.0	150.0	130	°C	10
MODBUS_ADDR	P92 - Serial identification number	0	255	1		1
MODBUS_BAUD	P93 - Serial baud rate			192	Kbit/s	1
STO_WAIT	P94 - Safe Torque Off waiting time	0	2000	500	ms	1
MOT_PRB_RES_THR	P95 - Motor NTC or PTC resistance value for alarm	0	50000	1500	Ohm	1
PRC_MOT_DO_TEMP_THR	P96 - Motor thermal logic output 14 cut-in threshold	0.0	200.0	100	%	40.96
DCBUS_MIN_MAIN_LOST	P97 - Minimum voltage level for forced mains off	0.0	1200.0	425	V	10
DCBUS_REF_MAIN_LOST	P98 - Voltage reference value in Support 1	0.0	1200.0	600	V	10
BLU_PAR_KEY	P99 - Access key to BLU parameters	0	19999	0		1

Name	Description	Min	Max	Default	UM	Scale
RES_PAR_KEY_VAL	P100 - Value of access key to reserved parameters	0	19999	95		1
DRV_F_PWM	P101 - PWM frequency	1000	16000	5000	Hz	1
PRC_DEAD_TIME_CMP	P102 - Dead time compensation	0.0	100.0	22.0	‰ PRC_MOT_V_MAX	32.76
PRC_DRV_I_MAX	P103 - Drive limit current	0.0	800.0	200	% DRV_I_NOM	40.96
T_RAD	P104 - Radiator time constant	10.0	360.0	80	s	10
KP_DCBUS	P105 - Corrective factor for Bus voltage	80.0	200.0	100	%	10
DCBUS_MIN	P106 - Minimum voltage of DC Bus	0.0	1200.0	400	V	10
DCBUS_MAX	P107 - Maximum voltage of DC Bus	0.0	1200.0	760	V	10
DCBUS_BRAKE_ON	P108 - Bus voltage threshold for brake ON	0.0	1200.0	730	V	10
DCBUS_BRAKE_OFF	P109 - Bus voltage threshold for brake OFF	0.0	1200.0	720	V	10
OFFSET_AO1	P110 - Offset A/D 1	-100.0	100.0	0		327.67
OFFSET_AO2	P111 - Offset A/D 2	-100.0	100.0	0	%	327.67
DISPLAY_WAIT	P112 - Display time to come back to idle state	3	600	10	s	1
DRV_I_PEAK	P113 - Maximum drive current	0.0	3000.0	0	A	10
PRC_I_TEST_CONN	P114 - Current in connection tests for UVW, Poles and reading Rs	0.0	100.0	100	% DRV_I_NOM	327.67
KP_MOT_THERM_PRB	P115 - Multiplication factor for motor PTC/NTC/KTY84 analog reference value	0.00	200.00	100		163.84
T_JUNC	P116 - Junction time constant	0.1	10.0	3.5	s	10
KP_DRV_THERM_PRB	P117 - Multiplication factor for radiator PTC/NTC analog reference value	0.00	200.00	100		163.84
DRV_TEMP_MAX	P118 - Max. temperature permitted by radiator PTC/NTC	0.0	150.0	90	°C	10
DRV_START_TEMP_MAX	P119 - Max. temperature permitted by radiator PTC/NTC for start-up	0.0	150.0	75	°C	10
DRV_DO_TEMP_THR	P120 - Radiator temperature threshold for logic output o.15	0.0	150.0	80	°C	10
TEST3-4_ACC_TIME	P121 - Test 3 and 4 acceleration time	0.01	199.99	4.0	s	100
MOD_INDEX_MAX	P122 - Max. modulation index	0.500	0.995	0.98		1000
DCBUS_REF	P123 - Smart brake voltage cut-in level	0.0	1200.0	750	V	10
PRC_ENC_OUT_LOOP	P124 - Simulated encoder Kv gain multiplication coeff.	0.0	100.0	100	%	327.67
PRC_V_REF_DCBUS	P125 - Voltage reference function of DC bus	0.0	100.0	96.00513	%	327.67
PRC_I_REG_KP_COEFF	P126 - KpI Corrective coeff. estimated Kp for current loops	0.0	200.0	100	%	40.96
PRC_V_REG_KP_COEFF	P127 - KpV Corrective coeff. estimated Kp for voltage loops	0.0	798.0	100	%	40.95
MOT_V0	P128 - Voltage motor at nominal speed with no load	0.0	100.0	100.0	% MOT_V_NOM	327.67
PRC_I_TEST_DELTA_VLS	P129 - Test current to establish VLS	0.0	100.0	15.0	%	327.67
TEST_SPD_T_MAX	P130 - Torque during start-up test	0.0	100.0	100	% MOT_T_NOM	40.96
K_FLX45	P131 - Magnetic characteristic point 1	0.0	120.0	90.2	%	40.96
TEST_SPD_MAX	P132 - Speed during start-up test	-100.00	100.00	100	% MOT_SPD_MAX	163.84
K_FLX55	P133 - Magnetic characteristic point 2	0.0	120.0	90.5	%	40.96
TEST_SPD_SPACE_MAX	P134 - Maximum revolutions during start-up test	0.00	3000.0	100	revolutions	10
K_FLX65	P135 - Magnetic characteristic point 3	0.0	120.0	91.1	%	40.96
PRC_MOT_FRICTION	P136 - Friction torque	0.0	100.0	0	% MOT_T_MOM	40.96
K_FLX75	P137 - Magnetic characteristic point 4	0.0	120.0	91.8	%	40.96
KP_REG_THERM_PRB	P138 - Multiplication factor for regulation card thermal probe	0.00	200.00	100		163.84
K_FLX82	P139 - Magnetic characteristic point 5	0.0	120.0	92.7	%	40.96
BRAKE_R	P140 - Braking resistance	1	1000	82	Ohm	1
K_FLX88	P141 - Magnetic characteristic point 6	0.0	120.0	94.2	%	40.96
BRAKE_R_MAX_EN	P142 - Braking resistance Maximum adiabatic Energy	0.0	500.0	4.5	KJoule	10
K_FLX93	P143 - Magnetic characteristic point 7	0.0	120.0	95.8	%	40.96
BRAKE_R_MAX_EN_TIME	P144 - Time measure of Braking resistance adiabatic Energy	0	30000	2000	ms	1
K_FLX97	P145 - Magnetic characteristic point 8	0.0	120.0	98.1	%	40.96
BRAKE_R_MAX_POWER	P146 - Maximum Power dissipated on Braking resistance	0.0	600.0	1.5	KWatt	100
K_FLX100	P147 - Magnetic characteristic point 9	0.0	120.0	100.0	%	40.96
BRAKE_R_TF	P148 - Power dissipated on Braking resistance filter time constant	1	2000	720	s	1
K_FLX102	P149 - Magnetic characteristic point 10	0.0	120.0	102.0	%	40.96

Name	Description	Min	Max	Default	UM	Scale
KP_POS_VF	P150 - High precision analog speed reference value:VCO setting for positive voltage reference values	-16383	16383	4096		1
PRC_DEAD_TIME_CMP_XB	P151 - Xb = cubic coupling zone amplitude	0.0	50.0	5.0	% DRV_I_NOM	163.84
POS_REG_SENS2_NUM	P152 - NUM - Second sensor incremental position loop	-16384	16384	100		1
POS_REG_SENS2_DEN	P153 - DEN - Second sensor incremental position loop	0	16384	100		1
PW_SOFT_START_TIME	P154 - Soft start enabling time	150	19999	500	ms	1
OVR_LOAD_T_ENV	P155 - Ambient temperature reference value during overload	0.0	150.0	40	°C	10
DRV_F_PWM_CARATT	P156 - PWM frequency for drive definition	1000	16000	5000	Hz	1
DEAD_TIME_SW	P157 - Dead time software duration	0.0	20.0	4	µs	10
PRC_I_DECOUP	P158 - Corrective coefficient for decoupling terms	0.0	200.0	50.0	%	40.96
KP_NEG_VF	P159 - High precision analog speed reference value:VCO setting for negative voltage reference values	-16383	16383	4096		1
I_DELAY_COMP	P160 - PWM delay compensation on the currents	-800.0	800.0	52	% TPWM	40.96
V_DELAY_COMP	P161 - PWM delay compensation on the voltages	-800.0	800.2	142.0	% TPWM	40.96
ID_CANOPEN	P162 - CAN BUS node ID	1	127	1		1
ALL_ENAB	P163 - Alarm enable	0	65535	65535	Hex	1
KP_SINCOS1_CHN	P164 - Resolver or Incremental Sin/Cos sine and cosine signal amplitude compensation	0.0	200.0	100	%	163.84
OFFSET_SIN1	P165 - Resolver or Incremental Sin/Cos sine offset	-16383	16383	0		1
OFFSET_COS1	P166 - Resolver or Incremental Sin/Cos cosine offset	-16383	16383	0		1
DRV_E_CARATT	P167 - Characterization voltage	200.0	780.0	400	V rms	10
SPD_REG_KD_TF2	P168 - Second order feedforword filter	0.0	1000.0	0.0	ms	10
START_TIME	P169 - Start up time	0	19999	100	ms	1
PRC_VF_SLIP_CMP	P170 - Slip motor compensation	0.0	400.0	0.0	% PRC_MOT_F_MAX	327.67
VF_TF_SLIP_CMP	P171 - Slip compensation factor filter	0.0	150.0	35.0	ms	10
PRC_VF_BOOST	P172 - Stator voltage drop compensation	0.0	400.0	70.0	% PRC_DELTA_VRS	40.96
PRC_VF_DCJ_I_MAX	P173 - Current limit during continuous braking	0.0	100.0	100.0	% DRV_I_NOM	40.96
PRC_VF_DCJ_F_MAX	P174 - Continuous breaking maximum frequency limit	0.0	100.0	0.0	% PRC_MOT_F_MAX	40.96
PRC_VF_CHR_V1	P175 - V/f characteristic point 1 voltage	0.0	100.0	0.0	% PRC_MOT_V_MAX	40.96
PRC_VF_CHR_F1	P176 - V/f characteristic point 1 frequency	0.0	100.0	0.0	% PRC_MOT_F_MAX	40.96
PRC_VF_CHR_V2	P177 - V/f characteristic point 2 voltage	0.0	100.0	0.0	% PRC_MOT_V_MAX	40.96
PRC_VF_CHR_F2	P178 - V/f characteristic poitn 2 frequency	0.0	100.0	0.0	% PRC_MOT_F_MAX	40.96
DB1_START	P179 - Dead zone 1 initial speed	0	30000	0	rpm	1
DB1_END	P180 - Dead zone 1 final speed	0	30000	0	rpm	1
DB2_START	P181 - Dead zone 2 initial speed	0	30000	0	rpm	1
DB2_END	P182 - Dead zone 2 final speed	0	30000	0	rpm	1
PRC_VF_V_REG_D	P183 - Voltage regulator derivative coefficient multiplying term	0.0	100.0	100.0	%	327.67
PRC_VF_FSTART_SEARCH	P184 - Initial search frequency with rotating motor	0.0	100.0	100.0	% PRC_MOT_F_MAX	40.96
PRC_VF_FMIN_SEARCH	P185 - Minimum search frequency with rotating motor	0.0	100.0	2.9	% PRC_MOT_F_MAX	40.96
VF_STALL_TIME	P186 - Working time during limit	1	100	30	s	1
PRC_VF_V_MAX_STATIC	P187 - Vs amplitude maximum static value	0.0	100.0	97.5	% PRC_MOT_V_MAX	327.67
TI_ENERGY_SAVE	P188 - Energy saving regulator filter time constant	100	2000	100	ms	1
PRC_FLX_MIN_ENERGY	P189 - Energy saving admissible minimum flux	0.0	100.0	20.0	% MOT_FLX_NOM	40.96
VF_TF_I_MAX_AL	P190 - Current alarm filter	0.0	150.0	10.0	ms	10
PRC_VF_T_MAX_SEARCH	P191 - Torque limit during fly restart	0.0	100.0	5.0	% DRV_T_NOM	40.96
PRC_IQ_COMP_THR	P192 - Minimum Active Current for sensorless flux compensation	0.0	400.0	50.0	% DRV_T_NOM	40.96

Name	Description	Min	Max	Default	UM	Scale
PRC_FLUX_COMP_THR	P193 - Maximum Flux for sensorless flux compensation	0.0	400.0	90.0	% MOT_FLX_NOM	40.96
PRC_VS_COMP_THR	P194 - Minimum Voltage for sensorless flux compensation	0.0	400.0	50.0	% MOT_V_NOM	40.96
DRV_K_ALTITUDE	P195 - Drive Derating with altitude	0.0	200.0	100.0	%	163.84
PWM_RID_F_MAX	P196 - Max frequency for PWM reduction	0.0	1000.0	10.0	Hz	10
PWM_MIN	P197 - Minimum PWM frequency	1000	16000	5000	Hz	1
DEAD_TIME_HW	P198 - Dead time hardware duration	0.0	20.0	0.0	µs	10
MIN_PULSE	P199 - Minumum command pulse duration	0.0	20.0	1.0	µs	10
SENSOR_SEL	C00 - Speed sensor	0	21	1		1
LI1_SEL	C01 - Meaning of logic input 1	-1	31	8		1
LI2_SEL	C02 - Meaning of logic input 2	-1	31	2		1
LI3_SEL	C03 - Meaning of logic input 3	-1	31	3		1
LI4_SEL	C04 - Meaning of logic input 4	-1	31	0		1
LI5_SEL	C05 - Meaning of logic input 5	-1	31	4		1
LI6_SEL	C06 - Meaning of logic input 6	-1	31	12		1
LI7_SEL	C07 - Meaning of logic input 7	-1	31	5		1
LI8_SEL	C08 - Meaning of logic input 8	-1	31	22		1
FRQ_IN_SEL	C09 - Frequency input setting	0	3	1		1
LO1_SEL	C10 - Meaning of logic output 1	-64	63	3		1
LO2_SEL	C11 - Meaning of logic output 2	-64	63	0		1
LO3_SEL	C12 - Meaning of logic output 3	-64	63	6		1
LO4_SEL	C13 - Meaning of logic output 4	-64	63	19		1
DISPLAY_SEL	C14 - Display selection	0	127	0		1
AO1_SEL	C15 - Meaning of programmable analog output 1	-99	100	11		1
AO2_SEL	C16 - Meaning of programmable analog output 2	-99	100	4		1
SENSOR2_SEL	C17 - Sensor2 selection	0	14	0		1
EN_TIME_DEC_ENC2	C18 - Enable incremental encoder2 time decode	0	1	0		1
EN_SLOT_SWAP	C19 - Enable sensor slot swap	0	1	0		1
EN_INV_POS2_DIR	C20 - Invert sensor2 positive cyclic versus	0	1	0		1
SW_RUN_CMD	C21 - Run software enable	0	1	1		1
LEM_SEL	C22 - LEM selection	0	1	1		1
EN_SYNC_REG	C23 - Enable CANOpen SYNC traking loop	0	1	0		1
DC_BUS_FULL_SCALE	C24 - DC Voltage drive full scale	0	2	0	V	1
RES2_DDC_BW	C25 - Second Resolver DDC bandwidth	0	1	0	Hz	1
EN_RND_RAMP	C27 - Rounded ramp	0	1	0		1
EN_STOP_MIN_SPD	C28 - Stop with minimum speed	0	1	0		1
DRV_SW_EN	C29 - Drive software enable	0	1	1		1
ALL_RESET	C30 - Reset alarms	0	1	0		1
DIS_DCBUS_RIPPLE_ALL	C31 - Disable DC Bus Ripple Alarm	0	1	0		1
EN_MOT_THERMAL_ALL	C32 - Motor thermal switch ' Block drive ?	0	1	1		1
MOT_THERM_CURV_SEL	C33 - Auto-ventilated thermal motors	0	3	0		1
MAIN_LOST_SEL	C34 - Managing mains failure	0	4	0		1
ALL_RST_ON_MAIN	C35 - Automatic alarm reset when mains back on	0	1	0		1
EN_PW_SOFT_START	C37 - Enable soft start	0	1	1		1
MAGN_SEL	C38 - Motor Magnetization selection	0	2	0		1
EN_I_CNTRL_SPD_LIM	C39 - Enable speed limitation in current control	0	1	0		1
EN_TEST_CONN	C41 - Enable sensor and motor phase tests	0	2	0		1
EN_AUTOTUNING	C42 - Enable auto-tunings	0	3	0		1
ALL_COUNT_RESET	C44 - Reset alarm counters	0	2	0		1
RECT_BRIDGE_SEL	C45 - Rectification bridge	0	1	0		1
MOT_THERM_PRB_SEL	C46 - Enable motor thermal probe management	0	4	1		1
EN_DCBUS_MAX_CTRL	C47 - Enable smart brake	0	1	0		1
CANOPEN_BAUD_SEL	C48 - CAN Baud rate	0	7	0		1
ENC_OUT_ZERO_TOP	C49 - TOP zero phase for simulated encoder	0	3	0		1
ENC_OUT_DIR	C50 - Invert channel B simulated encoder	0	1	0		1
ENC_OUT_PPR_SEL	C51 - Choose pulses ev. simulated encoder	0	12	5		1
ENC_OUT_SEL	C52 - Simulated encoder selection	0	5	0		1
MAIN_SUPPLY_SEL	C53 - Supply voltage	0	2	0		1
OPD_ENC_OUT_SEL	C54 - Internal Simulated Encoder selection	0	2	0		1

Name	Description	Min	Max	Default	UM	Scale
I_RELAY_SEL	C55 - Current relay output	0	2	0		1
I_OVR_LOAD_SEL	C56 - Current overload	0	3	3		1
DRV_THERM_PRB_SEL	C57 - Enable radiator heat probe management (PTC/NTC)	0	1	1		1
DIS_I_DECOUP	C59 - Disable dynamic decoupling + feedfoward	0	1	0		1
PAR_ACT_BANK	C60 - Parameter bank active	0	1	0		1
DEF_PAR_RD	C61 - Read default parameters	0	1	0		1
EEPROM_PAR_RD	C62 - Read parameters from EEPROM	0	2	0		1
EEPROM_PAR_WR	C63 - Save parameters in EEPROM	0	1	0		1
EN_FLDBUS	C64 - Enable fieldbus manage	0	4	0		1
EN_ON_LINE_CMP	C65 - Enable sensorless on line parameters compensation	0	3	1		1
RES_DDC_BW	C66 - Resolver DDC bandwidth	0	1	0	Hz	1
RES_CARR_FRQ_RATIO	C67 - Resolver carrier frequency	-3	3	0		1
EN_PWM_VAR	C68 - Enable PWM frequency variation	0	2	0		1
EN_TF2_SPD_REG	C69 - Enable 2nd order filter on speed regulator	0	1	0		1
MOT_PRB_RES_THR_MUL	C70 - Motor NTC or PTC resistance multiplication factor	0	1	0		1
EN_BRAKE_R_PROT	C71 - Enable Braking resistance protection	0	2	0		1
EN_SPD_FFW	C72 - Enable speed feedforward	0	2	0		1
EN_STO_ONLY_SIG	C73 - Enable Safety STOP only like signaling	0	1	0		1
EN_TIME_DEC_ENC	C74 - Enable incremental encoder time decode	0	1	0		1
DIS_DEF_START_AUTO	C75 - Disable Autotuning starting from default values	0	1	0		1
EN_INV_POS_DIR	C76 - Invert positive cyclic versus	0	1	0		1
EN_SPD_REG_MEM_CORR	C77 - Enable PI speed gains compenstation	0	1	0		1
MOT_SPD_MAX_MUL	C78 - Motor speed max multiplication factor	0	1	0		1
EN_NOT_LI	C79 - Enable negative logic for digital inputs	0	255	0		1
EN_VF_CNTL	C80 - Enable V/f control	0	1	0		1
EN_DB	C81 - Enable dead zones	0	2	0		1
VF_EN_STALL_ALL	C82 - Enable stall alarm	0	1	1		1
VF_EN_DCJ	C83 - Enable dc brake	0	1	0		1
VF_EN_SEARCH	C84 - Enable search during motor rotation	0	4	0		1
VF_EN_OPEN_LOOP	C85 - Enable open loop working state	0	2	0		1
EN_ENERGY_SAVE	C86 - Enable energy saving	0	1	0		1
VF_EN_BYPASS	C87 - Enable flux angle bypass - frequency input	0	1	0		1
VF_EN_CHR_AUTOSET	C88 - Calculate V/f characteristic nominal knee	0	1	0		1
DIS_MIN_VBUS	C89 - Disable minimum power circuit voltage with drive stopped	0	1	0		1
EN_POS_REG_SENS2	C90 - Enable incremental position loop on second sensor	0	1	0		1
EN_BRAKE_IN_STOP	C91 - Enable DC braking also in stop	0	1	0		1
NOTCH_DEEP	C92 - Notch filter deep	0	1	0.1		100
NOTCH_RID	C93 - Notch filter reduction	0	1	1.0		100
DRV_TH_MODEL	C94 - Drive Thermal Model	0	2	0		1
EN_AI1_4_20mA	C95 - Enable AI1 4-20mA	0	1	0		1
EN_AI2_4_20mA	C96 - Enable AI2 4-20mA	0	1	0		1
EN_AI3_4_20mA	C97 - Enable AI3 4-20mA	0	1	0		1
EN_BOOT	C98 - Enable boot mode	0	1	0		1
EN_AI1	E00 - Enable analog reference value A.I.1	0	1	0		1
EN_AI2	E01 - Enable analog reference value A.I.2	0	1	0		1
EN_AI3	E02 - Enable analog reference value A.I.3	0	1	0		1
AI1_SEL	E03 - Meaning of analog input A.I.1	0	7	0		1
AI2_SEL	E04 - Meaning of analog input A.I.2	0	7	1		1
AI3_SEL	E05 - Meaning of analog input A.I.3	0	7	2		1
TF_TRQ_REF_AN	E06 - Filter time constant for analog torque reference value	0.0	20.0	0	ms	10
EN_AI16	E07 - Enable analog reference value A.I.16	0	1	0		1
AI16_SEL	E08 - Meaning of analog input A.I.16	0	7	0		1
PRC_SPD_TOT_AN_DZ	E09 - Analog Speed/PID Error -Dead zone amplitude	0.00	100.00	0	% MOT_SPD_MAX	163.84
PRC_SPD_JOG	E11 - Digital speed reference value (JOG1)	-100.00	100.00	0	% MOT_SPD_MAX	163.84
EN_SPD_JOG	E12 - Enable jog speed reference	0	1	0		1
PRC_START_DG_POT	E13 - Motor potentiometer starting speed	-100.0	100.0	2.002075	% MOT_SPD_MAX	163.84

Name	Description	Min	Max	Default	UM	Scale
EN_MEM_DG_POT	E14 - Load final digital potentiometer reference value	0	1	0		1
PRC_MAX_REF_DG_POT	E15 - CW motor potentiometer speed reference value	-105.02	105.02	105.02	% MOT_SPD_MAX	163.84
PRC_MIN_REF_DG_POT	E16 - CCW motor potentiometer speed reference value	-105.02	105.02	-105.02	% MOT_SPD_MAX	163.84
DG_POT_RAMPS	E17 - Digital potentiometer acceleration time	0.3	1999.9	50	s	10
EN_DG_POT	E18 - Enable motor potentiometer reference value(A.I.4)	0	1	0		1
FRQ_IN_PPR_SEL	E20 - Encoder pulses per revolution	0	9	5		1
FRQ_IN_NUM	E21 - NUM - Frequency input slip ratio	-16383	16383	100		1
FRQ_IN_DEN	E22 - DEN - Frequency input slip ratio	0	16383	100		1
EN_FRQ_REF	E23 - Enable frequency speed reference value	0	1	0		1
FRQ_REF_SEL	E24 - Frequency speed reference selection	0	2	0		1
TF_TIME_DEC_FRQ	E25 - Filter time constant of frequency input decoded in time	0.0	20.0	1.6	ms	10
KP_TIME_DEC_FRQ	E26 - Corrective factor for frequency input decoded in time	0.0	200.0	100		163.84
SB_MOT_SPD_MAX	E27 - Second bank Max. operating speed	50	30000	3000	rpm	1
SB_SPD_REG_KP	E28 - Second bank KpV speed regulator proportional gain	0.1	400.0	6		10
SB_SPD_REG_TI	E29 - Second bank TiV speed regulator lead time constant	0.1	3000.0	30	ms	10
SB_SPD_REG_TF	E30 - Second bank TfV speed regulator (filter) time constant	0.0	25.0	0.4	ms	10
SB_CW_ACC_TIME	E31 - Second bank CW acceleration time	0.01	199.99	10	s	100
SB_CW_DEC_TIME	E32 - Second bank CW deceleration time	0.01	199.99	10	s	100
SB_CCW_ACC_TIME	E33 - Second bank CCW acceleration time	0.01	199.99	10	s	100
SB_CCW_DEC_TIME	E34 - Second bank CCW deceleration time	0.01	199.99	10	s	100
SB_ON	E35 - Second bank active	0	1	0		1
EN_LIN_RAMP	E36 - Enable linear ramp	0	1	1		1
EN_INV_SPD_REF	E37 - Invert reference signal software	0	1	0		1
EN_I_CNTRL	E38 - Enable only current control	0	1	0		1
EN_POS_REG	E39 - Enable overlapped space loop	0	1	0		1
EN_POS_REG_MEM_CLR	E40 - Enable overlapped space loop memory clear in stop	0	1	0		1
MUL_AI_IN_SEL	E41 - Multiplication factor selection	0	4	0		1
MUL_AI_OUT_SEL	E42 - Multiplication factor target	0	2	0		1
MUL_AI_MAX	E43 - Max analog input value for multiplication factor	-180.00	180.00	100.0	% A.I.	163.84
MUL_AI_MIN	E44 - Min analog input value for multiplication factor	-180.00	180.00	0.0	% A.I.	163.84
MUL_KCF_MAX	E45 - Multiplication factor with max analog input (MUL_AI_MAX)	-100.0	100.0	1.0		100
MUL_KCF_MIN	E46 - Multiplication factor with min analog input (MUL_AI_MAX)	-100.0	100.0	-1.0		100
EN_FLDBUS_REF	E47 - Enable FIELD-BUS reference values	0	1	0		1
STR_MUL_AI	E48 - Storing input multilpicative factor	0	2	0		1
EN_I_FF	E49 - Enable feedforward torque reference in speed control	0	1	0		1
DIS_STOP_POS	E54 - Disable Stop in position when incremental position loop is enabled	0	1	0		1
EN_STOP_POS	E55 - Enabling Stop in position	0	2	0		1
STOP_POS_CMD	E56 - Stop in position comand selection	0	1	0		1
EN_STOP_POS_GBOX	E57 - Enabling Stop in position after gearbox	0	1	0		1
ZERO_TOP_SEL	E58 - Stop in position comand selection	0	3	0		1
PRC_SPD_INDEX	E59 - Indexing speed reference value	0.00	100.00	2.0	% MOT_SPD_MAX	163.84
STOP_POS0	E60 - Target 0 Stop in position	0.00	100.00	0	% 360 degree	163.84
STOP_POS1	E61 - Target 1 Stop in position	0.00	100.00	0	% 360 degree	163.84
STOP_POS2	E62 - Target 2 Stop in position	0.00	100.00	0	% 360 degree	163.84
STOP_POS3	E63 - Target 3 Stop in position	0.00	100.00	0	% 360 degree	163.84
ANG_MOV	E64 - Angular movement Stop in position	-50.00	50.00	0	% 360 degree	163.84
POS_WINDOW	E65 - Position Reached window	0.00	50.00	0.15	% 360 degree	163.84
TIME_WINDOW	E66 - Time on Position Reached window	0	19999	10	ms	1
PRC_SPD_MIN_AUTO	E67 - Minimum speed for automatic stop	0.00	100.00	1.0	% MOT_SPD_MAX	163.84
SPD_MIN_HYST	E68 - Minimum speed hysteresis	0.00	100.00	0.0	% MOT_SPD_MAX	163.84
GBOX_NUM	E69 - Gearbox NUM	0	16384	100		1
GBOX_DEN	E70 - Gearbox DEN	0	16384	100		1

Name	Description	Min	Max	Default	UM	Scale
EN_PID	E71 - Enabling PID Control	0	2	0		1
DGT_SP_PID	E72 - Digital Setpoint PID	-200.0	200.0	0.0	%	163.84
SEL_SP_PID	E73 - PID Setpoint selection	0	6	0		1
SEL_PV_PID	E74 - PID Process value selection	0	6	1		1
KP_PID	E75 - KP proportional gain	-200.0	200.0	1.00		163.84
TF_PID_KP	E76 - Filter time constant component P PID	0.0	20.0	0.4	ms	10
TI_PID	E77 - TI Integral time	0	19999	0	ms	1
TD_PID	E78 - TD Derivative time	0	19999	0	ms	1
LMN_MIN_OUT_PID	E79 - Limit Min value of output PID	-200.0	200.0	-100.0	%	163.84
LMN_MAX_OUT_PID	E80 - Limit Max value of output PID	-200.0	200.0	100.0	%	163.84
EN_REF_PID	E81 - Enabling PID Reference	0	1	0		1
SEL_OUT_PID	E82 - PID Output selection	0	7	0		1
OVR_LMN_I	E83 - Override Integral Part of PID	-200.0	200.0	0.0	%	163.84
EN_PWM_SYNC	E87 - Enable PWM synchronization	0	2	0		1
PWM_SYNC_PHASE	E88 - PWM synchronization phase	-175.0	175.0	0	degrees	10
EN_HLD_BRAKE	E89 - Enable Motor Holding brake	0	1	0		1
HLD_BRAKE_DIS_DLY	E90 - Motor holding brake disable delay at start	0	19999	0	ms	1
HLD_BRAKE_EN_DLY	E91 - Motor holding brake enable delay at stop	0	19999	0	ms	1
EN_STOP_POS_AUTOSET	E92 - Enable autoset current position as stop in position target	0	1	0		1
TEMP_ON_CONV_FANS	E93 - Switch-on temperature of converter fans	30	80	60	°C	1
DRV_TEMP_TH_MODEL	Radiator temperature used by Thermal Model			0	°C	100
DRV_I_CONN_TH_MODEL	Drive inner connection limit			0	% DRV_I_CONN_MAX	100
PRC_FLD_SPD_REF	Fieldbus speed reference	-100.00	100.00	0	% MOT_SPD_MAX	163.84
PRC_FLD_T_MAX	Fieldbus maximum torque reference	-400.00	400.00	0	% MOT_T_NOM	40.96
PRC_FLD_T_REF	Fieldbus torque reference	-400.00	400.00	0	% MOT_T_NOM	40.96
OFFSET_AI1_BLU	Factory corrective offset for analog reference 1 (AI1)	-100.0	100.0	0	%	163.84
OFFSET_AI2_BLU	Factory corrective offset for analog reference 2 (AI2)	-100.0	100.0	0	%	163.84
OFFSET_AI3_BLU	Factory corrective offset for analog reference 3 (AI3)	-100.0	100.0	0	%	163.84
KP_DCBUS_BLU	Factory corrective factor for Bus voltage	0.0	200.0	100	%	10
KP_MOT_THERM_PRB_BLU	Factory multiplication factor for motor PTC/NTC/KTY84 analog reference value	0.00	200.00	100		163.84
KP_DRV_THERM_PRB_BLU	Factory multiplication factor for radiator PTC/NTC analog reference value	0.00	200.00	100		163.84
FW_REV	D00 - Software version			0		256
ACTV_POW	D01 - Active power delivered			0	kW	16
PRC_TOT_APP_SPD_REF	D02 - Speed reference value before ramp	-100	100	0	% MOT_SPD_MAX	163.84
PRC_END_SPD_REF	D03 - Speed reference value after ramp	-100	100	0	% MOT_SPD_MAX	163.84
PRC_MOT_SPD	D04 - Speed reading	-100	100	0	% MOT_SPD_MAX	163.84
PRC_T_REF	D05 - Torque request	-100	100	0	% MOT_T_NOM	40.96
PRC_IQ_REF	D07 - Request torque current Iq rif	-100	100	0	% DRV_I_NOM	40.96
PRC_ID_REF	D08 - Request magnetizing current Id rif	-100	100	0	% DRV_I_NOM	40.96
V_REF	D09 - Voltage reference value at max. rev.	-100	100	0	% MOT_V_NOM	40.96
PRC_APP_T_REF	D10 - Torque reference value (application generated)	-100	100	0	% MOT_T_NOM	40.96
MOT_I	D11 - Current module			0	A rms	16
REF_FRQ_IN	D12 - Frequency in input			0	KHz	16
EL_FRQ	D13 - Rotor flux frequency			0	Hz	16
PRC_APP_FRQ_SPD_REF	D14 - Frequency speed reference value (application generated)	-100	100	0	% MOT_SPD_MAX	163.84
PRC_IQ	D15 - Current torque component	-100	100	0	% DRV_I_NOM	40.96
PRC_ID	D16 - Current magnetizing component	-100	100	0	% DRV_I_NOM	40.96
MOT_V	D17 - Stator voltage reference value module			0	V rms	16
PRC_MOT_V	D18 - Stator voltage reference value module	-100	100	0	% MOT_V_NOM	40.96
MOD_INDEX	D19 - Modulation index	-100	100	0		40.96
PRC_VQ_REF	D20 - Vq rif	-100	100	0	% MOT_V_NOM	40.96
MOT_SPD	D21 - Motor rotation speed			0	rpm	1
PRC_VD_REF	D22 - Vd rif	-100	100	0	% MOT_V_NOM	40.96
PRC_RES_AMPL	D23 - Amplitude Resolver Signals	0	800	0	% ALL_THR	40.96
DC_BUS	D24 - Bus voltage			0	V	16
DRV_TEMP	D25 - Radiator temperature reading			0	°C	16

Name	Description	Min	Max	Default	UM	Scale
MOT_TEMP	D26 - Motor temperature			0	°C	16
MOT_FLX	D27 - Motor Flux			0	% MOT_FLX_NOM	40.96
PRC_DRV_I_THERM	D28 - Motor thermal current	-100	100	0	% soglia All	40.96
PRC_DRV_I_MAX	D29 - Current limit	-100	100	0	% DRV_I_NOM	40.96
PRC_DRV_T_MAX	D30 - Maximum torque	-100	100	0	% MOT_T_NOM	40.96
PRC_DRV_I_T_MAX	D31 - Maximum torque by current limit	-100	100	0	% MOT_T_NOM	40.96
PRC_APP_T_MAX	D32 - Maximum torque limit by application	-100	100	0	% MOT_T_NOM	40.96
PRC_APP_SPD_REF	D33 - Speed reference (application generated)	-100	100	0	% MOT_SPD_MAX	163.84
SOFT_START_STATE	D34 - Power Soft Start state			8		1
PRC_MOT_T	D35 - Actual torque produced	-400	400	0	% MOT_T_NOM	40.96
MOT_TURN_POS	D36 - Absolute mechanical position (on current revolution)			0	±16384	1
MOT_N_TURN	D37 - Number of revolutions			0		1
OFFSET_SINCOS_ENC	D38 - Compensation Sin/Cos analog/digital term			0	pulses	1
SENSOR_FRQ_IN	D39 - Input frequency			0	kHz	16
REG_CARD_TEMP	D40 - Regulation card temperature			0	°C	16
MOT_PRB_RES	D41 - Thermal probe resistance			0	KOhm	16
AI1	D42 - Analog Input AI1	-100	100	0	%	40.96
AI2	D43 - Analog Input AI2	-100	100	0	%	40.96
AI3	D44 - Analog Input AI3	-100	100	0	%	40.96
IGBT_J_TEMP	D45 - IGBT junction temperature			0	°C	16
IGBT_J_TEMP_MARGIN	D46 - IGBT junction temperature margin with its limit			0	°C	16
CPLD_FW_REV	D47 - CPLD software version			0		1
PRC_APP_T_MIN	D48 - Minimum torque limit by application	-100	100	0	% MOT_T_NOM	40.96
WORK_HOURS	D49 - Work Hours			0	hours	1
SENS2_SPD	D51 - Second sensor rotation speed			0	rpm	1
SENS2_TURN_POS	D52 - Second sensor Absolute mechanical position (on current revolution)			0	16384	1
SENS2_N_TURN	D53 - Second sensor Number of revolutions			0	16384	1
SENS2_FRQ_IN	D54 - Second sensor Frequency input			0	KHz	16
SENS1_ZERO_TOP	D55 - Sensor1 Zero Top			0	pulses	1
SENS2_ZERO_TOP	D56 - Sensor2 Zero Top			0	pulses	1
PRC_SPD_REF_MAX	D57 - Max positive speed ref			0	% MOT_SPD_MAX	163.84
PRC_SPD_REF_MIN	D58 - Max negative spd_ref			0	% MOT_SPD_MAX	163.84
SERIAL_NUMBER	D59 - Drive Serial Number			0		1
FLD_CARD	D60 - Fieldbus Card			0		1
APPL_REV	D61 - Application Revision			0		163.84
HW_SENSOR2	D62 - Sensor2 presence			0		1
HW_SENSOR1	D63 - Sensor1 presence			0		1
REF_AI1	D64 - Reference from Analog Input AI1	-100	100	0	%	40.96
REF_AI2	D65 - Reference from Analog Input AI2	-100	100	0	%	40.96
REF_AI3	D66 - Reference from Analog Input AI3	-100	100	0	%	40.96
PRC_SPD_REF_DG_POT	D67 - Digital Potentiometer Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_T_REF_AN	D68 - Analog Torque reference from Application	-400	400	0	% MOT_T_NOM	40.96
PRC_T_REF_FLDBUS	D69 - Fieldbus Torque reference	-400	400	0	% MOT_T_NOM	40.96
PRC_T_MAX_AN_POS	D70 - Analog Positive Torque Max from Application	-400	400	0	% MOT_T_NOM	40.96
PRC_T_MAX_FLDBUS	D71 - Fieldbus Torque Max reference	-400	400	0	% MOT_T_NOM	40.96
PRC_SPD_TOT_AN	D72 - Speed reference from AI1 + AI2 + AI3 + AI16	-100	100	0	% MOT_SPD_MAX	163.84
MUL_KP	D73 - Multiplication factor	-100.0	100.0	0		16
PRC_SPD_REF_AN	D74 - Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_SPD_REF_FLDBUS	D75 - Fieldbus Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_SPD_REF_JOG	D76 - Jog Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
PRC_SPD_REF_TIME_DEC	D77 - Time Decode Frequency input Speed reference	-100	100	0	% MOT_SPD_MAX	163.84
SPD_REF_PULS_FLDBUS	D78 - Fieldbus Speed Reference in Pulses			0	Pulses per Tpwm	1
REF_AI16	D79 - Reference from analog Input AI16				%	40.96
PRC_T_MAX_AN_NEG	D80 - Analog Negative Torque Max from Application	-400	400	0	% MOT_T_NOM	40.96
PWM_SYNC_DELAY	D81 - PWM SYNC delay	-400	400	0	us	16
PRC_SPD_MAX_AN_POS	D82 - Analog Positive Speed Max from Application	-200	200	0	% MOT_SPD_NOM	40.96

Name	Description	Min	Max	Default	UM	Scale
PRC_SPD_MAX_AN_NEG	D83 - Analog Negative Speed Max from Application	-200	200	0	% MOT_SPD_NOM	40.96
ACT_SP_PID	D85 - Actual Setpoint PID				%	163.84
ACT_PV_PID	D86 - Actual Feed-back PID				%	163.84
ACT_COM_P_PID	D87 - Actual Componente P of PID				%	163.84
ACT_COM_I_PID	D88 - Actual Componente I of PID				%	163.84
ACT_COM_D_PID	D89 - Actual Componente D of PID				%	163.84
ACT_ERR_PID	D90 - Actual Errore SP-PV of PID				%	163.84
ACT_OUT_PID	D91 - Actual Output PID				%	163.84
EN_SENSOR2_TUNE	U00 - Enable sensor2 auto-tuning	0	1	0		1
EN_TEST_SPD	U01 - Enable test of start-up time	0	2	0		1
SPD_REG_SETTING	U02 - Speed regulator autosetting	0	4	0		1
MAPPING_CONFIG	U03 - Select the mapping configuration	0	32767	0	Hex	1
EN_SENSOR_TUNE	U04 - Enable sensor auto-tuning	0	2	0		1
EN_START_UP_APPL	U05 - Enable Quick Start Application	0	1	0		1
START_UP_SPD_SEL	U06 - Quick Start Application Speed Reference Selection	0	4	0		1
START_UP_RUN_SEL	U07 - Quick Start Application Run command Input Selection	0	8	4		1
START_UP_EN_REF	U08 - Quick Start Application Enable Reference	0	1	1		1
START_UP_EN_LIN_RAMP	U09 - Quick Start Application Linear Ramps Enable	0	1	1		1
EN_I_VECTOR	U10 - Enable Current Vector for Power Part Test	0	1	0		1
I_VECTOR_FREQ	U11 - Current Vector frequency for Power Part Test	0	200	50	Hz	1
NODE_SLAVE_ADDR	F00 - Slave address	0	255	0		
NODE_BAUD_RATE	F01 - Node baudrate	0000	FFFF	0000	HEX	
DATA_CONSISTANCE	F02 - Data consistence	0	1	0		
EN_ACYCLIC_DATA	F03 - Enable acyclic data	0	1	1		
EN_BIG_ENDIAN	F04 - Most significant bytes in multi-byte data types	0	1	1		
PDP_SETUP_DATA	F05 - Old profibus DP setup data	0000	F	0000	HEX	
FLDB_ERROR_CODE	F06 - Fieldbus error code	0000	F		HEX	
FLDB_STATE	F07 - Fieldbus state	0000	F		HEX	
IP_ADDR_00	F08 - Anybus IP Address 00	0	255	192		
IP_ADDR_01	F09 - Anybus IP Address 01	0	255	168		
IP_ADDR_02	F10 - Anybus IP Address 02	0	255	0		
IP_ADDR_03	F11 - Anybus IP Address 03	0	255	0		
SUBNET_MASK_00	F12 - Anybus Subnet Mask 00	0	255	255		
SUBNET_MASK_01	F13 - Anybus Subnet Mask 01	0	255	255		
SUBNET_MASK_02	F14 - Anybus Subnet Mask 02	0	255	255		
SUBNET_MASK_03	F15 - Anybus Subnet Mask 03	0	255	0		
GATEWAY_00	F16 - Anybus Gateway 00	0	255	0		
GATEWAY_01	F17 - Anybus Gateway 01	0	255	0		
GATEWAY_02	F18 - Anybus Gateway 02	0	255	0		
GATEWAY_03	F19 - Anybus Gateway 03	0	255	0		
DHCP	F20 - Anybus DHCP	0	1	1		
ANYBUS_EN	F21 - Anybus module enabled	0000	FFFF		HEX	
ANYBUS_STATE	F22 - Anybus module state	0000	FFFF		HEX	
MAP_ERROR_CODE	F23 - Mapping Error Code	0000	FFFF	0000	HEX	
MAP_ERROR_OBJ	F24 - Mapping Error Object	0000	FFFF	0000	HEX	
RX0_INDEX	F25 - Receive Object0 Index	0000	FFFF	0000	HEX	
RX0_SUB_INDEX	F26 - Receive Object0 Sub-Index	0000	FFFF	0000	HEX	
RX1_INDEX	F27 - Receive Object1 Index	0000	FFFF	0000	HEX	
RX1_SUB_INDEX	F28 - Receive Object1 Sub-Index	0000	FFFF	0000	HEX	
RX2_INDEX	F29 - Receive Object2 Index	0000	FFFF	0000	HEX	
RX2_SUB_INDEX	F30 - Receive Object2 Sub-Index	0000	FFFF	0000	HEX	
RX3_INDEX	F31 - Receive Object3 Index	0000	FFFF	0000	HEX	
RX3_SUB_INDEX	F32 - Receive Object3 Sub-Index	0000	FFFF	0000	HEX	
RX4_INDEX	F33 - Receive Object4 Index	0000	FFFF	0000	HEX	
RX4_SUB_INDEX	F34 - Receive Object4 Sub-Index	0000	FFFF	0000	HEX	
RX5_INDEX	F35 - Receive Object5 Index	0000	FFFF	0000	HEX	
RX5_SUB_INDEX	F36 - Receive Object5 Sub-Index	0000	FFFF	0000	HEX	
RX6_INDEX	F37 - Receive Object6 Index	0000	FFFF	0000	HEX	
RX6_SUB_INDEX	F38 - Receive Object6 Sub-Index	0000	FFFF	0000	HEX	
RX7_INDEX	F39 - Receive Object7 Index	0000	FFFF	0000	HEX	

Name	Description	Min	Max	Default	UM	Scale
RX7_SUB_INDEX	F40 - Receive Object7 Sub-Index	0000	FFFF	0000	HEX	
RX8_INDEX	F41 - Receive Object8 Index	0000	FFFF	0000	HEX	
RX8_SUB_INDEX	F42 - Receive Object8 Sub-Index	0000	FFFF	0000	HEX	
RX9_INDEX	F43 - Receive Object9 Index	0000	FFFF	0000	HEX	
RX9_SUB_INDEX	F44 - Receive Object9 Sub-Index	0000	FFFF	0000	HEX	
TX0_INDEX	F45 - Transmit Object0 Index	0000	FFFF	0000	HEX	
TX0_SUB_INDEX	F46 - Transmit Object0 Sub-Index	0000	FFFF	0000	HEX	
TX1_INDEX	F47 - Transmit Object1 Index	0000	FFFF	0000	HEX	
TX1_SUB_INDEX	F48 - Transmit Object1 Sub-Index	0000	FFFF	0000	HEX	
TX2_INDEX	F49 - Transmit Object2 Index	0000	FFFF	0000	HEX	
TX2_SUB_INDEX	F50 - Transmit Object2 Sub-Index	0000	FFFF	0000	HEX	
TX3_INDEX	F51 - Transmit Object3 Index	0000	FFFF	0000	HEX	
TX3_SUB_INDEX	F52 - Transmit Object3 Sub-Index	0000	FFFF	0000	HEX	
TX4_INDEX	F53 - Transmit Object4 Index	0000	FFFF	0000	HEX	
TX4_SUB_INDEX	F54 - Transmit Object4 Sub-Index	0000	FFFF	0000	HEX	
TX5_INDEX	F55 - Transmit Object5 Index	0000	FFFF	0000	HEX	
TX5_SUB_INDEX	F56 - Transmit Object5 Sub-Index	0000	FFFF	0000	HEX	
TX6_INDEX	F57 - Transmit Object6 Index	0000	FFFF	0000	HEX	
TX6_SUB_INDEX	F58 - Transmit Object6 Sub-Index	0000	FFFF	0000	HEX	
TX7_INDEX	F59 - Transmit Object7 Index	0000	FFFF	0000	HEX	
TX7_SUB_INDEX	F60 - Transmit Object7 Sub-Index	0000	FFFF	0000	HEX	
TX8_INDEX	F61 - Transmit Object8 Index	0000	FFFF	0000	HEX	
TX8_SUB_INDEX	F62 - Transmit Object8 Sub-Index	0000	FFFF	0000	HEX	
TX9_INDEX	F63 - Transmit Object9 Index	0000	FFFF	0000	HEX	
TX9_SUB_INDEX	F64 - Transmit Object9 Sub-Index	0000	FFFF	0000	HEX	

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